



Taxonomic revision of the Australian Eucarpiini (Hemiptera: Fulgoromorpha: Cixiidae) with the description of nine new species

BIRGIT LÖCKER^{1,2,4}, MURRAY J. FLETCHER^{1,2} & GEOFF M. GURR^{1,3}

¹*Pest Biology & Management Group, University of Sydney, AUSTRALIA. E-mail: birgit.loecker@gmx.at*

²*Department of Primary Industries, Orange Agricultural Institute, AUSTRALIA. E-mail: murray.fletcher@dpi.nsw.gov.au*

³*EH Graham Centre for Agricultural Innovation, Charles Sturt University, AUSTRALIA. E-mail: Ggurr@csu.edu.au*

⁴*Corresponding author. E-mail: birgit.loecker@gmx.at*

Table of contents

Abstract	2
Introduction	2
Material and methods	2
Results	3
Checklist of Australian species of Eucarpiini	3
Key to Australian genera of Eucarpiini	3
Genus <i>Bajauana</i> Distant, 1907	4
Key to Australian species of <i>Bajauana</i> Distant	4
<i>Bajauana australis</i> (Kirkaldy, 1907)	4
<i>Bajauana acuminata</i> Löcker, sp. nov.	6
Genus <i>Dilacreon</i> Fennah, 1980	7
Subgenus <i>Dilacreon</i> (<i>Dilacreon</i>) Fennah, 1980	8
Key to Australian species of <i>Dilacreon</i> (<i>Dilacreon</i>) Fennah	8
<i>Dilacreon</i> (<i>Dilacreon</i>) <i>akethe</i> Löcker, sp. nov.	9
<i>Dilacreon</i> (<i>Dilacreon</i>) <i>granulinervis</i> (Muir, 1913), comb. nov.	10
<i>Dilacreon</i> (<i>Dilacreon</i>) <i>ispi</i> Löcker, sp. nov.	12
Genus <i>Kirbyana</i> Distant, 1906	14
<i>Kirbyana australis</i> (Muir, 1913)	14
Genus <i>Neocarpia</i> Tsaur & Hsu, 2003	17
<i>Neocarpia rhizophorae</i> Löcker, sp. nov.	17
Genus <i>Nesochlamys</i> Kirkaldy, 1907	19
Key to Australian species of <i>Nesochlamys</i> Kirkaldy	20
<i>Nesochlamys capensis</i> Löcker, sp. nov.	20
<i>Nesochlamys contrarius</i> Löcker, sp. nov.	20
<i>Nesochlamys jubatus</i> Löcker, sp. nov.	22
<i>Nesochlamys pandikros</i> Löcker, sp. nov.	24
<i>Nesochlamys yiralli</i> Löcker, sp. nov.	24
Genus <i>Eucarpia</i> Walker, 1857	25
Discussion	25
Acknowledgements	30
References	30

Abstract

The Australian planthopper tribe Eucarpiini is revised taxonomically. Five genera are recognised in the Australia fauna: *Bajauana* Distant 1907, *Dilacreon* Fennah, 1980, *Kirbyana* Distant, 1906, *Neocarpia* Tsaur & Hsu, 2003 and *Nesochlamys* Kirkaldy, 1907. Except for *Bajauana* all of these represent new records for Australia. *Eucarpia* Walker, 1857 is declared absent from Australia. Twelve species, nine of which are new, are recognised in the Australian fauna: *Bajauana acuminata*, **sp. nov.**, *Dilacreon akethe*, **sp. nov.**, *D. ispi*, **sp. nov.**, *Neocarpia rhizophorae*, **sp. nov.**, *Nesochlamys capensis*, **sp. nov.**, *N. contrarius*, **sp. nov.**, *N. jubatus*, **sp. nov.**, *N. pandikros*, **sp. nov.** and *N. yiralli*, **sp. nov.** Except for *Bajauana austrina* (Kirkaldy, 1907) and *D. (D.) granulinervis*, all species are endemic to Australia. Lectotypes are designated for *Australoma austrina* Kirkaldy, 1907, *Ptolema australis* Muir, 1913 and *P. granulinervis* Muir, 1913. New combinations proposed are: *Dilacreon (Dilacreon) granulinervis* (Muir, 1913) comb. nov. (from *Eucarpia*), *Kirbyana australis* (Muir, 1913) comb. nov. (from *Eucarpia*) and *Leptolamia praetextata* comb. nov. (from *Bajauana*, transfer from Eucarpiini to Cixiini). All Australian species of Eucarpiini are described and illustrated and identification keys to genera and species are provided.

Key words: Homoptera, planthopper, morphology, distribution, identification

Introduction

The planthopper family Cixiidae is distributed worldwide with its highest diversity in the tropics (Emeljanov 2002). Comprehensive revisions of the Australian taxa in the tribes Gelastocephalini (Löcker, *et al.* 2006a), Pentastirini (Löcker, *et al.* 2006b), Mnemosynini (Löcker, *et al.* 2006c) and Andini (Löcker, *et al.* 2007a) and in the genus *Innobindus* Jacobi, 1928 (Brixiini) (Löcker, *et al.* 2007b) have resulted in the discovery of 22 new genera and 101 new species and have more than doubled the number of Australian genera and tripled the number of Australian species previously known in these tribes.

Eucarpiini is one of eight tribes recorded from Australia and was created by Emeljanov (2002) to accommodate ten genera from the Palaearctic, Ethiopian, Oriental, Australian and Oceanic Regions (Holzinger *et al.* 2002). Fennah (1980) reassessed the status of several genera of the *Eucarpia* group and defined them as a complex of seven relatively weak genera for which he also provided an identification key: *Dystheatias* Kirkaldy, 1907, *Caneirona* Distant, 1916, *Eucarpia* Walker, *Kirbyana* Distant, *Phytoceptor* Fennah, 1980, *Dilacreon* Fennah, 1980 and *Bajauana* Distant, 1907. Our current study investigates how the Australian Eucarpiini fits into the generic concepts proposed by Fennah (1980) and more recent authors such as Tsaur and Hsu (2003).

Previously, the following Australian species and subspecies were listed under Eucarpiini (Fletcher, 2009): *Bajauana austrina* (Kirkaldy, 1907), *B. praetexta* (Jacobi, 1928), *B. praetexta* var. *obscura* (Jacobi, 1928) and *Eucarpia australis* (Muir, 1913). Examinations of specimens held in Australian and overseas collections revealed the presence of several new species of Australian Eucarpiini which are described in this paper.

Material and methods

The morphological terms applied here follow Löcker *et al.* (2006b) with the following exception. Counts of apical cells follow Mead and Kramer (1982) and not Löcker *et al.* (2006b), in order to make this manuscript easier to compare with other works published on Eucarpini, e.g. Tsaur & Hsu (2003). This means that total numbers of apical cells are in general increased by one compared to the counting used in Löcker *et al.* (2006b).

The following is a list of the measurements taken in this study:

body length: tip of head to posterior margin of forewing
length of forewing: base to posterior margin of forewing
width of forewing: at level of apex of clavus
length of vertex: in midline

width of vertex: at level of basal emargination
length of frons: in midline
width of frons: at level where frons is widest
apical segment of rostrum
subapical segment of rostrum

Depository abbreviations:

AMS Australian Museum, Sydney, Australia
ANIC Australian National Insect Collection, CSIRO, Canberra, ACT, Australia
ASCU Agricultural Scientific Collections Unit, Orange, NSW, Australia
BPBM Bernice Pauahi Bishop Museum, Honolulu, Hawaii, USA
MTD Museum für Tierkunde, Staatliche Naturhistorische Sammlungen, Dresden, Germany
QDPI Queensland Department of Primary Industries, Brisbane, Qld, Australia
QM Queensland Museum, Brisbane, Qld, Australia
UQIC University of Queensland Insect Collection, Brisbane, Qld, Australia

Results

Checklist of Australian species of Eucarpiini

Bajauana austrina (Kirkaldy, 1907)
Bajauana acuminata Löcker, **sp. nov.**
Dilacreon (Dilacreon) akethe Löcker, **sp. nov.**
Dilacreon (Dilacreon) granulinervis (Muir, 1913), comb. nov.
Dilacreon (Dilacreon) ispi Löcker, **sp. nov.**
Kirbyana australis (Muir, 1913)
Neocarpia rhizophorae Löcker, **sp. nov.**
Nesochlamys capensis Löcker, **sp. nov.**
Nesochlamys contrarius Löcker, **sp. nov.**
Nesochlamys jubatus Löcker, **sp. nov.**
Nesochlamys pandikros Löcker, **sp. nov.**
Nesochlamys yiralli Löcker, **sp. nov.**

Key to Australian genera of Eucarpiini

- 1 Vertex longer than wide (Fig. 10B). Head including eyes much narrower than pronotum (Fig. 10B). Forewing with MA apically bifid (Fig. 8D). Hind tibia with 5 apical teeth. Females with 8th sternite medially distinctly shorter than laterally.....Genus *Nesochlamys* Kirkaldy
- Vertex wider than long (Fig. 7C). Head including eyes not much narrower than pronotum (occasionally wider) (Fig. 7C). Forewing with MA apically trifid (Fig. 7B). Hind tibia with 6 apical teeth (the innermost tooth may be very inconspicuous). Females with 8th sternite medially distinctly longer than laterally..... 2
- 2(1) Subapical segment of rostrum more than 2.5 times longer than apical segment. Forewing with MP joining CuA directly without crossvein MP-CuA (Fig. 6C). Genus *Kirbyana* Distant
- Subapical segment of rostrum less than 2 times longer than apical segment. Forewing with crossvein MP-CuA (Figs 1B, 4B, 7B). 3
- 3(2) Hindwing with R forked apically (Fig. 1D).Genus *Bajauana* Distant
- Hindwing with R unforked apically (Fig. 4C). 4
- 4(3) Forewing with crossvein MP-CuA about as long as or longer than vein MP from M fork to crossvein MP-CuA (Fig. 7B). Lateral carinae of vertex strongly elevated. Innermost apical tooth of hind tibia not smaller or less sclerotised

- than other apical teeth.Genus *Neocarpia* Tsaour & Hsu
- Forewing with crossvein MP-CuA less than half as long as vein MP from M fork to crossvein MP-CuA (Figs 4B, 5B). Lateral carinae of vertex slightly elevated. Innermost apical tooth of hind tibia smaller and less sclerotised than other apical teeth.Genus *Dilacreon* Fennah

Genus *Bajauana* Distant, 1907

Bajauana Distant 1907a: 277.

Type species: *Brixia rufula* Walker, 1870, by original designation.

Australoma Kirkaldy, 1907: 114, synonymised by Fennah, 1980: 239.

Type species: *Australoma austrina* Kirkaldy, 1907, by monotypy.

Morphology. Body length: ♂ 4.2–5.1 mm; ♀ 4.3–5.5 mm.

Head: Head including eyes slightly narrower or about as wide as pronotum. Vertex much broader than wide in midline; anterior margin straight or weakly angulated; lateral margins strongly elevated; subapical carina absent. Frons invisible in dorsal view; broadening over very short distance, therefore lateral carinae distinctly concave; lateral carinae strongly elevated; position of maximum width of frons distinctly dorsad of centre of frontoclypeal suture; median carina incomplete or complete. Frontoclypeal suture distinctly semicircular, bent upwards, median part not reaching lower margin of antennal scape. Lateral carinae of anteclypeus well developed. Rostrum distinctly surpassing hind coxae, attaining level of middle of hind femora; subapical segment 1.2–1.9 times longer than apical segment.

Thorax: Mesonotum with lateral carinae straight or slightly curved, not sinuate. Forewings steeply tectiform; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell; Sc+R and M emerging from basal cell distinctly separately from CuA; Sc+R forking basad of fork CuA1+CuA2; crossvein MP-CuA (=M₃₊₄-Cu_{1a}) much shorter than MP (M₃₊₄) from M fork to crossvein and much shorter than crossvein R-M; RP apically bifid; MA apically trifid; 10 apical cells. Hindwing with R unforked. Hind leg: tibia with 6 apical teeth (innermost tooth smallest and least sclerotised); 1st tarsomere with 6 apical teeth.

Female genitalia: Ovipositor elongate, orthopteroid, slightly curved upwards, reaching but not surpassing anal style; 8th sternite medially very long, slightly bent dorsad, posterior margin u-shaped; anal segment square (as long as wide) or slightly trapezoid (narrower at apex) in dorsal view; anal style longer than wide; 9th tergite without wax plates.

Remarks. *Bajauana* comprises more than 50 species from New Guinea, Indonesia and Australia. *Bajauana praetextata* (Jacobi, 1928) was listed under Eucarpini in Fletcher (2009). Based on characters such as the carination of the head, the venation of the forewing and the chaetotaxy of the 2nd hind tarsomere, this species is here transferred to the genus *Leptolamia* Metcalf, 1936 (Tribe Cixiini) as *Leptolamia praetextata* (Jacobi, 1928) **comb. nov.**

Key to Australian species of *Bajauana* Distant

- 1 Face yellow with concolorous carinae as in Fig. 1E. Forewing hyaline yellowish except for three light to mid brown marks (one near apex of clavus, two on pterostigma) as in Fig. 1B. Phallotheca with four sclerotised spines inserting near apex of phallotheca as in Figs 11A, B. *Bajauana austrina* (Kirkaldy)
- Face light brown to mid brown, carinae distinctly paler as in Fig. 2B. Forewing hyaline colourless except for numerous (more than four) mid to dark brown marks scattered over the forewing as in Fig. 2A. Phallotheca with only one sclerotised spine inserting near apex of phallotheca as in Figs 12A, B. *Bajauana acuminata* Löcker, **sp. nov.**

Bajauana austrina (Kirkaldy, 1907)

(Figs 1, 11)

Australoma austrina Kirkaldy, 1907: 114, Pl. VIII, Figs 16–18.

Bajauana austrina (Kirkaldy), Fennah, 1980: 239.

Type. *Lectotype* ♂ (designated here, examined), **AUSTRALIA, Qld:** Kuranda, viii.1904 (BPBM).

Notes: One male type specimen from Kuranda, Queensland has been examined. It is unclear from the original description whether further type material exists - though it is unlikely because a single measurement instead of a range is given for the body length by Kirkaldy (1907). Nevertheless, the specimen is recognised as a syntype because of the possibility of additional type specimens and is hereby designated as lectotype to provide diagnostic reference for the species.

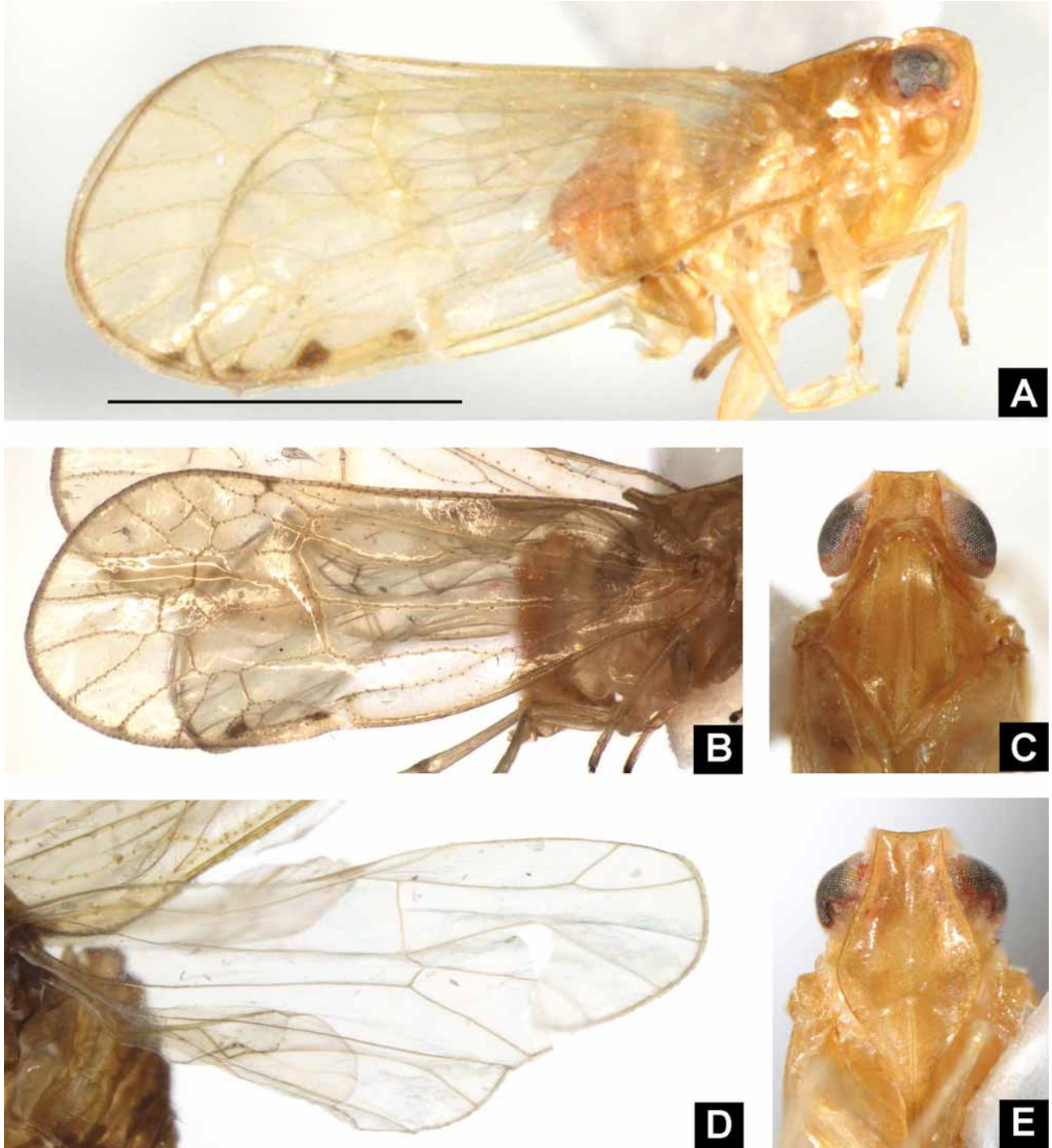


FIGURE 1. *Bajauana austrina*: A habitus lateral; B forewing; C dorsum; D hindwing; E face. Scalebar 2 mm applies to figure A.

Other material examined. AUSTRALIA, Qld: 1 ♂, Mossman Gorge, 21.iv.1967 (D.H. Colless) (ANIC); 2 ♀, same data, 23.iv.1967 (ANIC); 2 ♂, Windsor Tableland via Mt Carbine, 26.xii.1983–24.i.1984 (Storey & Halfpapp) (QDPI); 3 ♂, 1 ♀, same data, malaise trap, 10.xi.–26.xii.1983 (Storey & Titmarsh) (QDPI); 1 ♀, same data, 4.–29.xii.1980 (QDPI); 1 ♂, Kuranda Range State Forest, 7–8 m, Black Mtn Road, 20.iv.1967 (D.H. Colless) (ANIC); 1 ♀, Kuranda State Forest, 28.1 km N of Kuranda, 16°40'25"S 145°30'08"E, 28.iv.1998 (G. Cassis) (AMS).

Colour. Head yellow except for dark brown apex of rostrum. Pro- and mesonotum yellow, carinae concolorous or slightly paler. Forewings hyaline yellowish except for mid brown mark near apex of clavus; veins and tubercles yellow; pterostigma yellow except for two mid brown marks. Abdominal sternites yellow, sometimes mid brown. Legs yellow.

Morphology. Body length: ♂ 4.9–5.1 mm; ♀ 4.9–5.5 mm.

Head: Vertex 1.4–1.7 times wider than long; with or without indistinct median carina. Frons 1.0–1.2 times longer than wide. Median carina of frons complete, rarely incomplete.

Thorax: Forewing 2.5–2.7 times longer than wide; with about 21–24 tubercles on costa; position of crossvein R-M basad or at same level as fork MA-MP. Hind leg: 2nd tarsomere with 8 (rarely 7) apical teeth and three very fine setae.

Male genitalia: Anal tube as in Figs 11C, D. Genital styles as in Figs 11E, F. Ventromedian process of pygofer triangular as in Fig. 11E. Aedeagus as in Figs 11A, B. Phallosome left lateral with two more or less straight spines (a, b) of different length, right lateral with slightly curved, short spine (c) and long, more or less straight spine. (d). Flagellum with several pointed tips.

Remarks. *Bajauana austrina* has been recorded from Australia and Indonesia (Buru Island) and therefore represents one of two species within the Australian Eucarpini that are not endemic to Australia. *Bajauana austrina* can be distinguished from *B. acuminata* by the characters given in the key.

***Bajauana acuminata* Löcker, sp. nov.**

(Figs 2, 12)

Types. *Holotype* ♂, **AUSTRALIA, Qld:** 26 km up Tinaroo Ck Rd via Mareeba, 29.ix.–11.xi.1983 (Storey & Brown) (QM T.156363, originally from QDPI). *Paratypes*, **Qld:** 1 ♀, Kuranda Range State Forest, 20.iv.1967 (D.H. Colless) (ANIC); 1 ♀, Lambs Head (East End), 17°02'S 145°40'E, 1180 m, pyrethrum, trees & logs, 29.xi.1993 (Monteith & Janetzki) (QM); 1 ♀, Massey Ra., 6 km NW of Bellenden Ker, 17°14'S 145°48'E, 1150 m, pyrethrum, 11.x.1991 (Monteith & Janetzki) (QM); 1 ♀, Crawford's Lookout, Palmerston Nat. Pk., 1.iv.1976 (I.D. Galloway) (QDPI); 1 ♀, GS1 Mt Haig, 17.06S 145.36E, 1150 m, malaise trap, 29.ix.–31.x.1995 (L. Umbeck) (ANIC).

Etymology. The Latin term '*acuminatus*' means 'pointed'. Named after the pointed tips of the flagellum.

Colour. Head light brown to mid brown, carinae paler, apex of rostrum dark brown. Pro- and mesonotum light brown to mid brown, carinae paler. Forewings hyaline with numerous brown marks scattered over forewing, mainly along veins; veins and tubercles concolorous with cells; pterostigma light brown, sometimes with brown marks. Abdominal sternites mid to dark brown. Legs light brown.

Morphology. Body length: ♂ 4.2 mm; ♀ 4.3–4.8 mm.

Head: Vertex 2.0 times wider than long; with indistinct median carina, covering 3/4 of length of vertex. Frons 1.1 times longer than wide; median carina incomplete, covering more than 3/4 of length of frons.

Thorax: Forewing 2.5 times longer than wide; with 28–29 tubercles on costa; position of crossvein R-M basad of fork MA-MP. Hind leg: 2nd tarsomere with 7 apical teeth and three very fine setae.

Male genitalia: Anal tube as in Figs 12C, D. Genital styles as in Figs 12E, F. Ventromedian process of pygofer triangular as in Fig. 12E. Aedeagus as in Figs 12A, B. Phallosome ventrally with long, straight spine (a) inserted at apex of phallosome. Flagellum with several, more or less sclerotised, pointed tips.

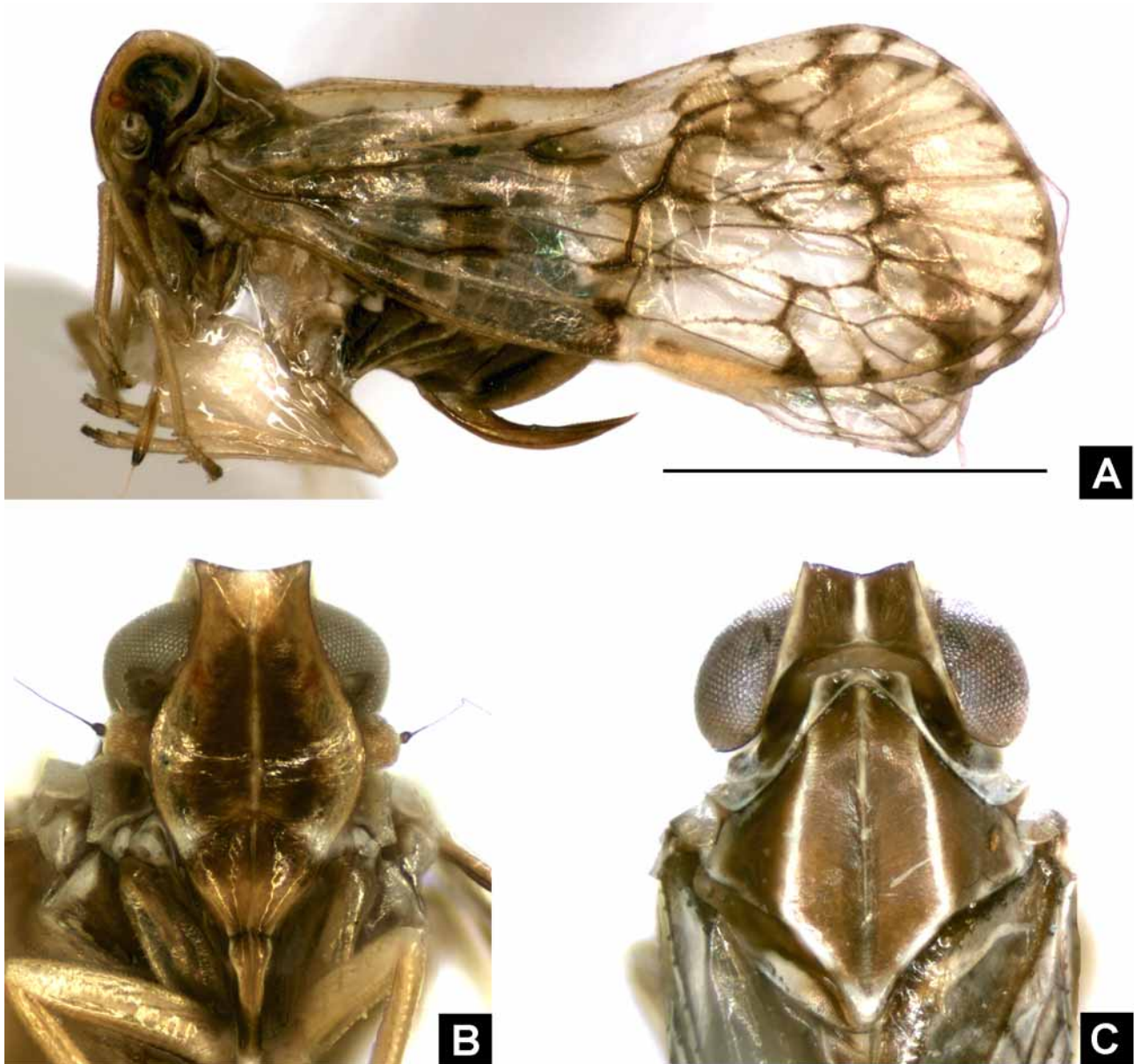


FIGURE 2. *Bajauana acuminata*: A habitus lateral (paratype); B face (holotype); C dorsum (paratype). Scalebar 2 mm applies to figure A.

Genus *Dilacreon* Fennah, 1980

Dilacreon Fennah, 1980: 242.

Type species: *Dystheatias orpheus* Fennah, 1956: 78, by original designation.

Morphology. Body length: ♂ 3.9–4.9 mm; ♀ 4.0–5.2 mm.

Head: Head including eyes about as wide as or wider than pronotum. Vertex with distinct or indistinct median carina covering entire length of vertex; lateral carinae slightly elevated; anterior margin of vertex straight or convex; subapical carina absent. Frons visible or invisible in dorsal view; maximum width of frons no more than 2x apical width; position of maximum width of frons distinctly dorsad of centre of frontoclypeal suture; median carina complete; lateral carinae slightly elevated. Frontoclypeal suture distinctly semicircular, bent upwards, median part not reaching lower margin of antennal scape. Lateral carinae of anteclypeus well developed. Rostrum just reaching or slightly surpassing hind coxae; subapical segment of rostrum 1.4–1.9 times longer than apical segment.

Thorax: Angle of hind margin of pronotum more or less rectangular. Forewing with crossvein MP-CuA less than half as long as vein MP from M fork to crossvein MP-CuA; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell or Sc+R+M forming very short common stem; crossvein MP-CuA much shorter than MP from M fork to crossvein and much shorter than crossvein R-M; RP apically bifid; MA apically trifid; 10 apical cells. Hind leg: tibia with 6 apical teeth (innermost tooth smallest and least sclerotised); 1st tarsomere with 7 (rarely 6) apical teeth; 2nd tarsomere with 8 apical teeth and 3 platellae or fine setae.

Female genitalia: Ovipositor elongate, orthopteroid, slightly curved upwards, reaching but not surpassing anal style; 8th sternite medially very long, slightly bent dorsad, posterior margin u-shaped; anal segment square (as long as wide) or rectangular (wider than long) in dorsal view; anal style as long as wide or slightly longer than wide; 9th tergite without wax plates.

Remarks. *Dilacreon* was previously represented by 16 species from the Australian and Oceanic Region but has not been recorded from Australia itself. Our study has revealed the presence of three species of *Dilacreon* in Australia. All Australian *Dilacreon* species share a very similar shape of the pygofer in lateral view, with a deep, rounded incision on the dorsal side leading into a parallelogram-shaped protuberance posterodorsally (13F, 14F, 15F). A similar incision can be found in some New Guinean species of *Dilacreon*, such as *D. (D.) nigricornis* Fennah, 1980, however the posterodorsal protuberance (if present at all) is differently shaped in those species. The thickness and size of the tooth-like appendices situated behind the row of apical teeth on the 2nd tarsomere varies considerably within the genus and even within the species *D. (D.) granulinervis*. Therefore different terms (fine setae and platellae) are used to describe them although they are most likely of the same evolutionary origin. *Dilacreon (D.) akethe* and *D. (D.) ispi* have very large and thick appendices (to which we refer as platellae), in *D. (D.) granulinervis* some specimens have platellae others possess much more delicate structures (to which we refer as fine setae).

Subgenus *Dilacreon (Dilacreon)* Fennah, 1980

Dilacreon (Dilacreon) Fennah, 1980: 242.

Note: Fennah (1980) divided *Dilacreon* into two subgenera, *Dilacreon* and *Eluzalmon* characterised by differences in the lateral margins of the frons and the presence (nominal subgenus) or absence (subgenus *Eluzalmon* Fennah) of a transverse veinlet from M to Cu₁ near Cu fork. The Australian species placed in *Dilacreon* all belong in the nominal subgenus, which is otherwise distributed in New Guinea, Indonesia (new generic record) and Palau (Micronesia). Species in the subgenus *Eluzalmon* are only known from New Guinea.

Key to Australian species of *Dilacreon (Dilacreon)* Fennah

- 1 Frons invisible in dorsal view (Fig. 4D). Mesonotum with lateral carinae sinuate as in Fig. 4D. Vertex with a well developed median carina. Apical lobes of anal tube with a pointed tip as in Fig. 14D. Genital styles without a tooth on the inner side of the basal arm (Fig. 14E). Aedeagus ventrally with a triangular and an ovoid shaped, flattened ridge as in Fig. 14B. *Dilacreon (Dilacreon) granulinervis* (Muir)
- Frons visible in dorsal view (Figs 3B, 5C). Mesonotum with lateral carinae straight or slightly curved as in Figs 3B, 5C. Vertex with an indistinct median carina. Apical lobes of anal tube with a rounded tip as in Figs 13D, 15D. Genital styles with a small tooth on the inner side of the basal arm (Figs 13E, 15E). Aedeagus ventrally without flattened ridges (Figs 13A, B, 15A, B). 2
- 2(1) Flagellum left laterally with two spines (d, e) as in Fig. 13A. Flagellum right laterally with a very long spine (b) and a short spine (c); spine (c) situated above midlength of flagellum (Fig 13B). *Dilacreon (Dilacreon) akethe* Löcker, **sp. nov.**
- Flagellum left laterally with only one spine (d) as in Fig. 15A. Flagellum right laterally with a very long spine (b) and a moderately long spine (c); spine (c) situated about midlength of flagellum (Fig 15B). *Dilacreon (Dilacreon) ispi* Löcker, **sp. nov.**

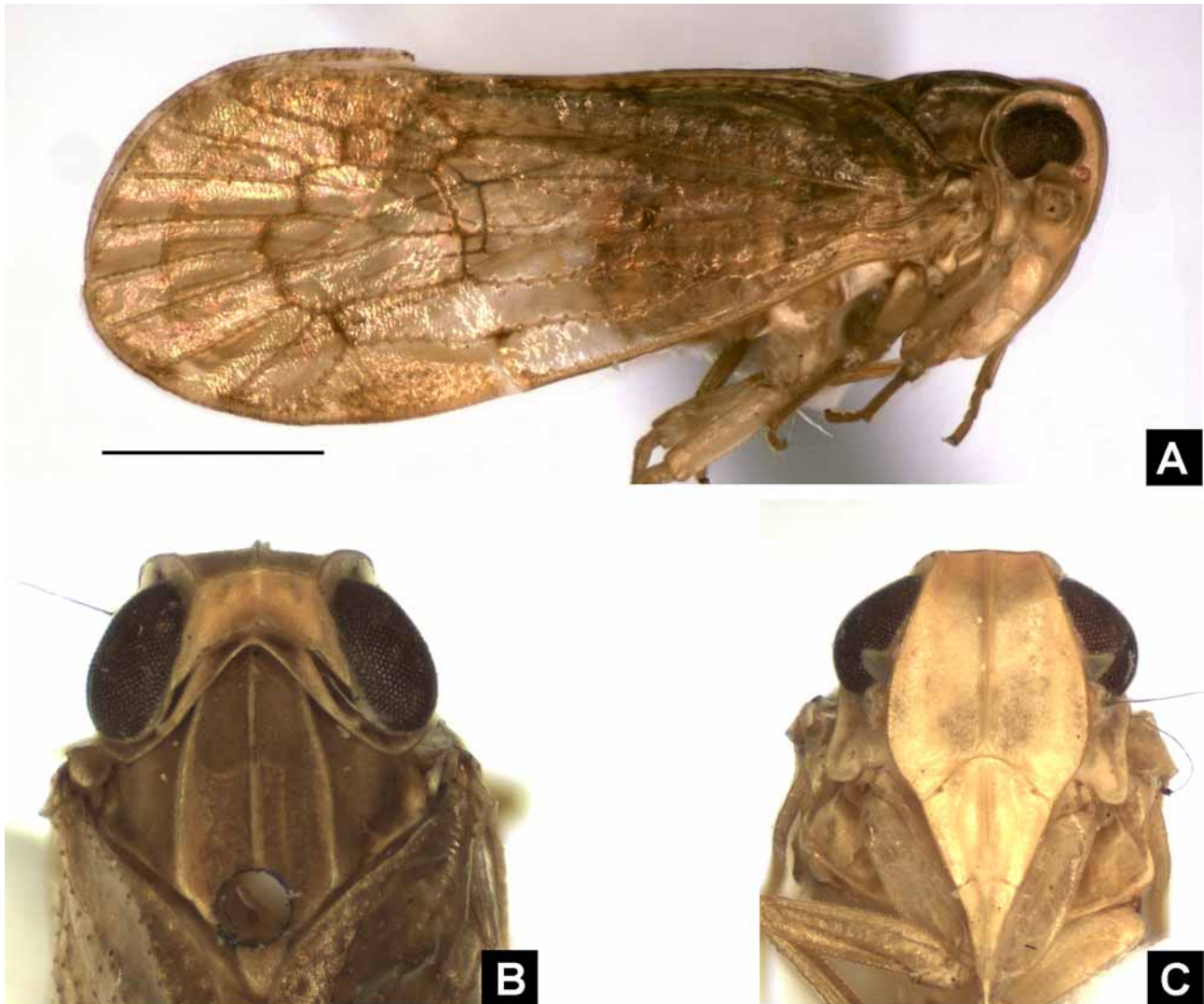


FIGURE 3. *Dilacreon (Dilacreon) akethe*: A habitus lateral (paratype); B dorsum (paratype); C face (paratype). Scalebar 1 mm applies to figure A.

***Dilacreon (Dilacreon) akethe* Löcker, sp. nov.**

(Figs 3, 13)

Types. *Holotype* ♂, **AUSTRALIA, Qld**: Lockerbie, Cape York, 6.–10.vi.1969, (G.B. Monteith) (QM T.156364, originally from UQIC). *Paratypes*, **Qld**: 1♂, 1♀, same data as holotype (UQIC).

Etymology. The term ‘*akethe*’ means ‘uncovered, exposed’ in Eastern Arrernte, an aboriginal language spoken in the region around Alice Springs (Thieberger & McGregor, 1994) and refers to the shape of the anal tube (large parts of the anal style and 11th abdominal segment are visible in lateral view).

Colour. Head, thorax and abdomen light brown. Forewings light brown except for slightly darker crossveins and some slightly darker marks near apex of forewing.

Morphology. Body length: ♂ 4.4–4.7 mm; ♀ 4.9 mm.

Head: Vertex 2.6–3.9 times wider than long; with indistinct median carina. Frons 1.0 times as long as wide; frons distinctly visible in dorsal view. Rostrum slightly surpassing hind coxae.

Thorax: Mesonotum with lateral carinae evenly curved as in Fig. 3A. Forewing 2.5–2.7 times longer than wide; with about 26–30 tubercles on costa; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell or Sc+R+M fused, forming very short common stem; Sc+R forking at same level as fork

CuA1+CuA2; position of crossvein R-M at same level as fork MA-MP.

Male genitalia: Anal tube (Figs 13C, D), slightly asymmetrical in dorsal view, apical lobes rounded in lateral view. Genital styles as in Figs 13E, F, with inner side of basal arm bearing small tooth. Ventromedian process of pygofer triangular as in Fig 13E. Aedeagus as in Figs 13A, B. Phallosome dorsally with very short spine (a) directed caudad; right laterally with very long spine (b) and left laterally with very long spine (d). Flagellum right laterally with short spine (c) situated above midlength of flagellum and left laterally with short, less sclerotised spine (e).

Remarks. This species is very similar in external appearance to *D. (D.) ispi*. Even the male genitalia closely resemble those of *D. (D.) ispi* but *D. (D.) akethe* can be distinguished from that species by the presence of two spines “d” and “e” on the left side of the aedeagus (only one spine “d” in *D. (D.) ispi*).

***Dilacreon (Dilacreon) granulinervis* (Muir, 1913), comb. nov.**

(Figs 4, 14)

Ptoleia granulinervis Muir, 1913: 256.

Eucarpia granulinervis (Muir), Fennah 1980: 238.

Dilacreon (Dilacreon) granulinervis (Muir), **comb. nov.**

Notes: *Eucarpia granulinervis* is hereby transferred into *Dilacreon (Dilacreon)* Fennah, based on the characters of the wings, chaetotaxy of the hind legs and shape and colour of the head as given in Fennah (1980). The transfer of this species to *Dilacreon* places this genus in the Indonesian fauna for the first time.

Types. *Lectotype* ♂ (here designated, examined), **INDONESIA:** Larat, Timor Laut Islands (792) (F. Muir) (BPBM). *Paralectotype*, **INDONESIA:** 1 ♀, same data, xii.1907 (BPBM).

Notes: The original description does not mention the designation of a holotype, therefore these specimens are regarded as syntypes. A lectotype is designated to provide a diagnostic reference for the species.

Other material examined. **AUSTRALIA, Qld:** 3♂, 1♀, St. Pauls, Moa Island, 10.11S 142.26E, at light, 10.–18.ii.1986 (K. Houston & E. Hamacek) (QDPI); 1♂, ‘Eclectus’, Iron Range, 12°45’46”S 143°17’10”E, 20 m, 12.vii.1997 (G. & A. Daniels) (UQIC); 1♂, Batavia Downs, 12.41S 142.41E, flight intercept trap, 22.vi.–23.viii.1992 (P. Zborowski & J. Cardale) (ANIC); 3♂, same data, malaise trap (ANIC); 17♂, 22♀, 5 km S Batavia Downs, 12.41S 142.41E, malaise trap, 24.v.–17.vi.1993 (P. Zborowski & I. Naumann) (ANIC); 1♀, same data, 4.iv.–24.v.1993 (P. Zborowski & A. Rosch) (ANIC); 5♂, 12♀, same data, 18.vi.–22.vii.1992 (P. Zborowski & E.S. Nielson) (ANIC); 1♀, same data, 8.iii.–4.iv.1993 (P. Zborowski) (ANIC); 1♂, same data, 12.40S 142.41E, flight intercept trap, 18.vi.–22.vii.1992 (P. Zborowski & E.S. Nielson) (ANIC); 5♂, 7♀, Heathlands, 11.45S 142.35E, flight intercept trap, 18.viii.–ix.1992 (P. Zborowski & L. Miller) (ANIC); 1♀, Lockerbie, Cape York, 6.–1.vi.1969 (G.B. Monteith) (UQIC); 1♀, Gordon Creek, Claudie River District, 12°42’S 143°17’E, mv lamp, 6.xii.1986 (G. Daniels & M.A. Schneider) (UQIC); 1♀, Mount Lamond, Iron Range, 28.vi.1982 (G. Daniels & M.A. Schneider) (UQIC).

Colour. Head, pro- and mesonotum light brown with concolorous carinae (some specimens with pale yellow carinae); face with three whitish spots along frontoclypeal suture as in Fig. 4E. Forewing hyaline light brown, sometimes with darker markings, veins concolorous with cells (some specimens with pale carinae); tubercles darker than veins and cells; pterostigma light brown. Fore- and midlegs light brown with mid brown transverse stripes as in Fig. 4A. Hind legs light brown, not striped, but with darkened areas around the apical teeth. Abdominal sternites light brown to mid brown.

Morphology. Body length: ♂ 3.9–4.7 mm; ♀ 4.0–4.8 mm.

Head: Vertex 1.9–2.4 times wider than long; with distinct median carina. Frons 0.8–1.0 times as long as wide; frons invisible in dorsal view. Rostrum slightly surpassing hind coxae.

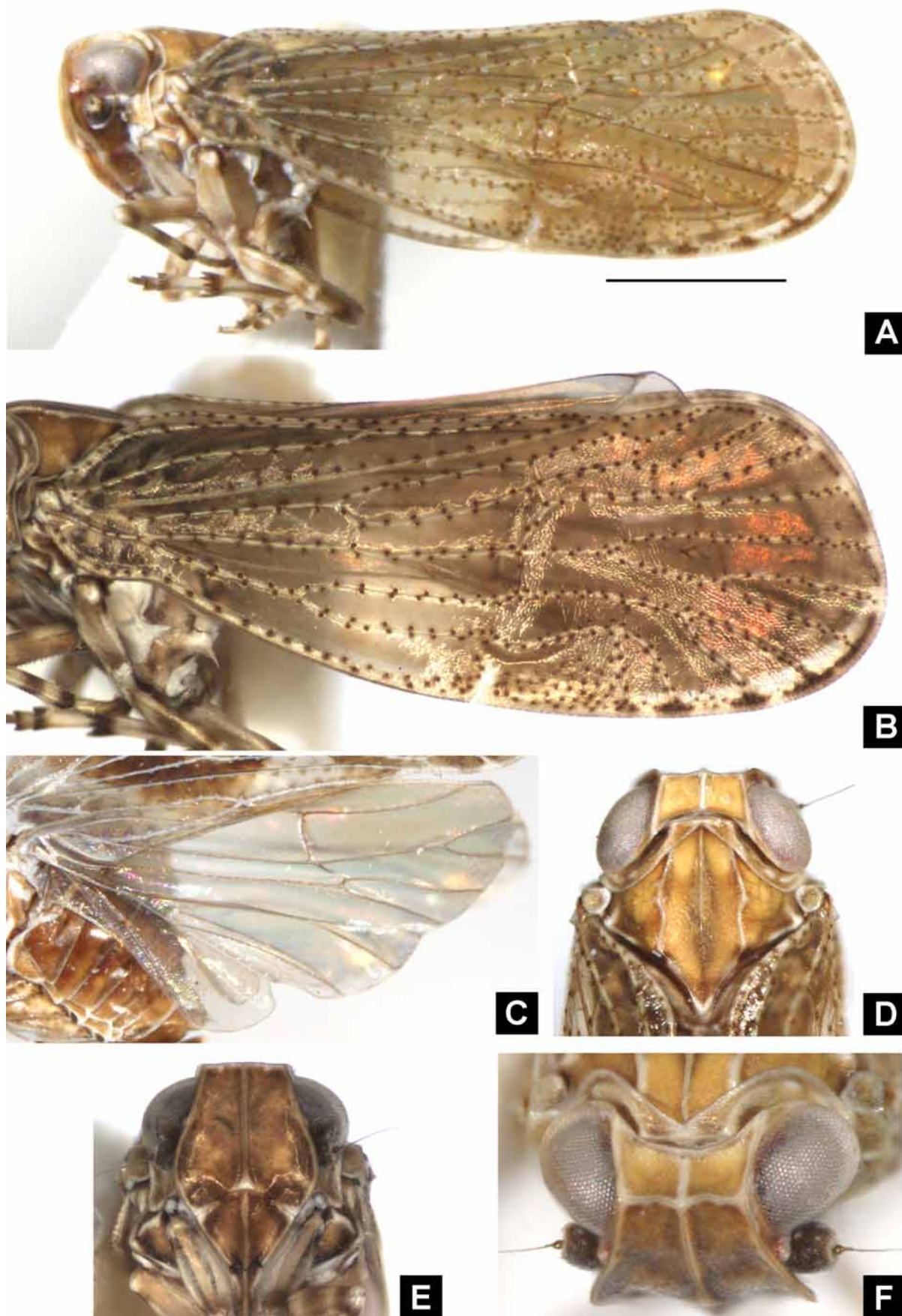


FIGURE 4. *Dilacreon (Dilacreon) granulinervis*: A habitus lateral; B forewing; C hindwing; D dorsum; E face; F head, anterodorsal view. Scalebar 1 mm applies to figure A.

Thorax: Mesonotum with lateral carinae sinuate as in Fig. 4D. Forewing 2.8–3.0 times longer than wide; with about 23–28 tubercles on costa; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell; Sc+R forking basad, at same level or distad of fork CuA1+CuA2; position of crossvein R-M at same level as fork MA-MP.

Male genitalia: Anal tube (Figs 14C, D), more or less symmetrical in dorsal view, apical lobes with pointed tip as in Fig. 14D. Genital styles as in Figs 14E, F, inner side of basal arm without tooth. Ventromedian process of pygofer triangular as in Fig 14E. Aedeagus as in Figs 14A, B. Phallosome ventrally with one triangular and one ovoid shaped, flattened ridge; right laterally with short spine (b) inserted near apex of aedeagus; left laterally with longer spine (d) directed cephalad and very thin spine (f) directed caudad. Flagellum dorsally with short spine (a); right laterally with longer spine (c) and left laterally with short spine (e).

Remarks. This species can be distinguished from the other two Australian species by the presence of a pointed tip on the apical lobes of the anal tube (rounded in *D. (D.) akethe* and *D. (D.) ispi*), by the presence of a triangular and an ovoid shaped, flattened ridge on the ventral side of the aedeagus (absent in *D. (D.) akethe* and *D. (D.) ispi*) and by the absence of a small tooth on the inner side of the basal arm of the genital style. *Dilacreon (D.) granulinervis* was previously known only from Indonesia but it seems to be a common species in North Queensland. Thirty-six males and 47 females have been found in the Australian material representing the first record of the species in Australia.

***Dilacreon (Dilacreon) ispi* Löcker, sp. nov.**

(Figs 5, 15)

Types. *Holotype* ♂, AUSTRALIA, NT: Holmes Jungle, Palm Cr., 15 km NE of Darwin, 5 m, 14–15.iii.1961 (J.L. & M. Gressitt) (BPBM Nr 17162). *Paratypes*, NT: 3 ♀, same data (BPBM); 1 ♂, 1 ♀, same data, 11.iii.1961 (BPBM); 1 ♂, 1 ♀, same data, 13.iii.1961 (BPBM); 1 ♀, same data, light trap, 14.iii.1961 (BPBM).

Etymology. The term ‘*ispi*’ means ‘to hide’ in Meryam Mir, an aboriginal language spoken in the Torres Strait (Thieberger & McGregor, 1994) and refers to the position of the anal style and 11th abdominal segment which are mostly concealed by the lobes of anal tube in lateral view.

Colour. As in *D. (D.) akethe*.

Morphology. Body length: ♂ 4.7–4.9 mm; ♀ 4.9–5.2 mm.

Head: Vertex 2.2–2.5 times wider than long; with indistinct median carina. Frons 0.9–1.0 times as long as wide; frons distinctly visible in dorsal view. Rostrum just reaching hind coxae.

Thorax: Mesonotum with lateral carinae straight or slightly curved (Fig. 5C). Forewing 2.3–2.6 times longer than wide; with about 20–23 tubercles on costa; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell; Sc+R forking slightly basad or at same level as fork CuA1+CuA2; position of crossvein R-M basad or at same level as fork MA-MP.

Male genitalia: Anal tube (Figs 15C, D), apex of anal tube distinctly asymmetrical in dorsal view (Fig. 15C); apical lobes rounded; anal style and 11th abdominal segment mostly concealed by lobes of anal tube in lateral view (Fig. 15D). Genital styles as in Figs 15E, F, with inner side of basal arm bearing small tooth. Ventromedian process triangular (Fig. 15E). Aedeagus as in Figs 15A, B. Phallosome dorsally with very short spine (a) directed caudad; right laterally with very long spine (b); left laterally with very long spine (d). Flagellum right laterally with moderately long spine (c) about midlength of flagellum.

Remarks. This species can be distinguished from the other two Australian species of *Dilacreon* by the position of the anal style and 11th abdominal segment, which are mostly concealed by the lobes of the anal tube in lateral view. In *D. (D.) granulinervis* and *D. (D.) akethe* large parts of the anal style and 11th abdominal segment are visible in lateral view.



FIGURE 5. *Dilacreon (Dilacreon) ispi*: A habitus lateral (holotype); B forewing (holotype); C dorsum (holotype); D face (holotype). Scalebar 1 mm applies to figure A.

Genus *Kirbyana* Distant, 1906

Kirbya Melichar, 1903: 37. preoccupied by *Kirbya* Robineau-Desvoidy, 1830 (Diptera).

Kirbyana Distant, 1906: 262, *nom. nov.* for *Kirbya* Melichar 1903.

Kirbyella Kirkaldy, 1906: 248, unnecessary *nom. nov.* for *Kirbya* Melichar, synonymised by Distant, 1916: 37.

Saccharias Kirkaldy, 1907: 125, synonymised by Fennah, 1980: 239.

Commolenda Distant, 1911: 741, synonymised by Fennah, 1978: 211.

Morphology. Head: Head including eyes slightly narrower than pronotum. Vertex in profile horizontal, in same line as thorax, meeting frons abruptly rectangulately; subapical carina absent. Frons somewhat longer than broad; median carina present; anterior margin angularly emarginate or transverse; position of maximum width of frons more or less around centre of frontoclypeal suture. Median ocellus absent. Subapical segment of rostrum 2.8 times longer than apical segment.

Thorax: Pronotum very narrow, scarcely half as long as vertex. Mesonotum nearly twice as long as pronotum and vertex together. Hindwing with simple Radius. Hind leg: tibia without lateral spines. Hind leg: tibia with 6 apical teeth (innermost tooth smallest and least sclerotised).

Female genitalia: Ovipositor elongate, orthopteroid, slightly curved upwards, just reaching anal style; 8th sternite medially very long, slightly bent dorsad, posterior margin u-shaped; anal segment rectangular (wider than long) in dorsal view; anal style much longer than wide; 9th tergite without wax plates.

Remarks. The information provided by Tsaur & Hsu (2003) about a median ocellus in *Kirbyana* is conflicting. In the identification key, the character state “median ocellus present” is used to differentiate *Kirbyana* from *Neocarpia* and *Eucarpia* (the latter two listed under “median ocellus absent”). However, in the generic description of *Kirbyana* it says “Median ocellus absent”. The same state is also provided in the generic descriptions of *Neocarpia* and *Eucarpia*. Other descriptions of *Kirbyana* or species currently recognised in *Kirbyana* do not explicitly mention the presence or absence of a median ocellus but it is assumed it would have been mentioned had there been one present, i.e. since some of the descriptions note that the ocelli are located near the eyes and others give detailed descriptions of the shape and colour of the face. The use of this feature by Tsaur and Hsu (2003) in their key to genera is in error since all three genera appear to lack a median ocellus.

Kirbyana australis (Muir, 1913)

(Figs 6, 16)

Ptoleria australis Muir, 1913: 258.

Eucarpia australis (Muir), Fennah 1980: 238.

Kirbyana australis (Muir), **new combination.**

Types. *Lectotype* ♂ (here designated, examined), AUSTRALIA, Qld: Cairns, viii.1904 (Perkins & Koebele) (BPBM).

Notes: The original description leaves open whether further type specimens exist although it is unlikely because a single measurement instead of a range is given for the body length and the length of the tegmen by Muir (1913). Nevertheless, the specimen is recognised as a syntype because of the possibility of additional specimens and is hereby designated as lectotype to provide a diagnostic reference for the species.

Other material examined. AUSTRALIA, NT: 1 ♀, 16 ml. W. of Humpty Doo, 10.vi.1964 (I. F. B. Common) (ANIC).

Colour. Vertex, pronotum and mesonotum with percurrent, parallel-sided, pale yellow stripe. Between stripe and lateral carinae, pro- and mesonotum brown. Frons mid brown speckled with small pale dots. Forewings hyaline light brown or mid brown with scattered darker marks, veins light brown, tubercles mid brown, pterostigma light brown. Abdomen light to mid brown, legs light brown.

Morphology. Body length: ♂ 4.5 mm; ♀ 4.8 mm.

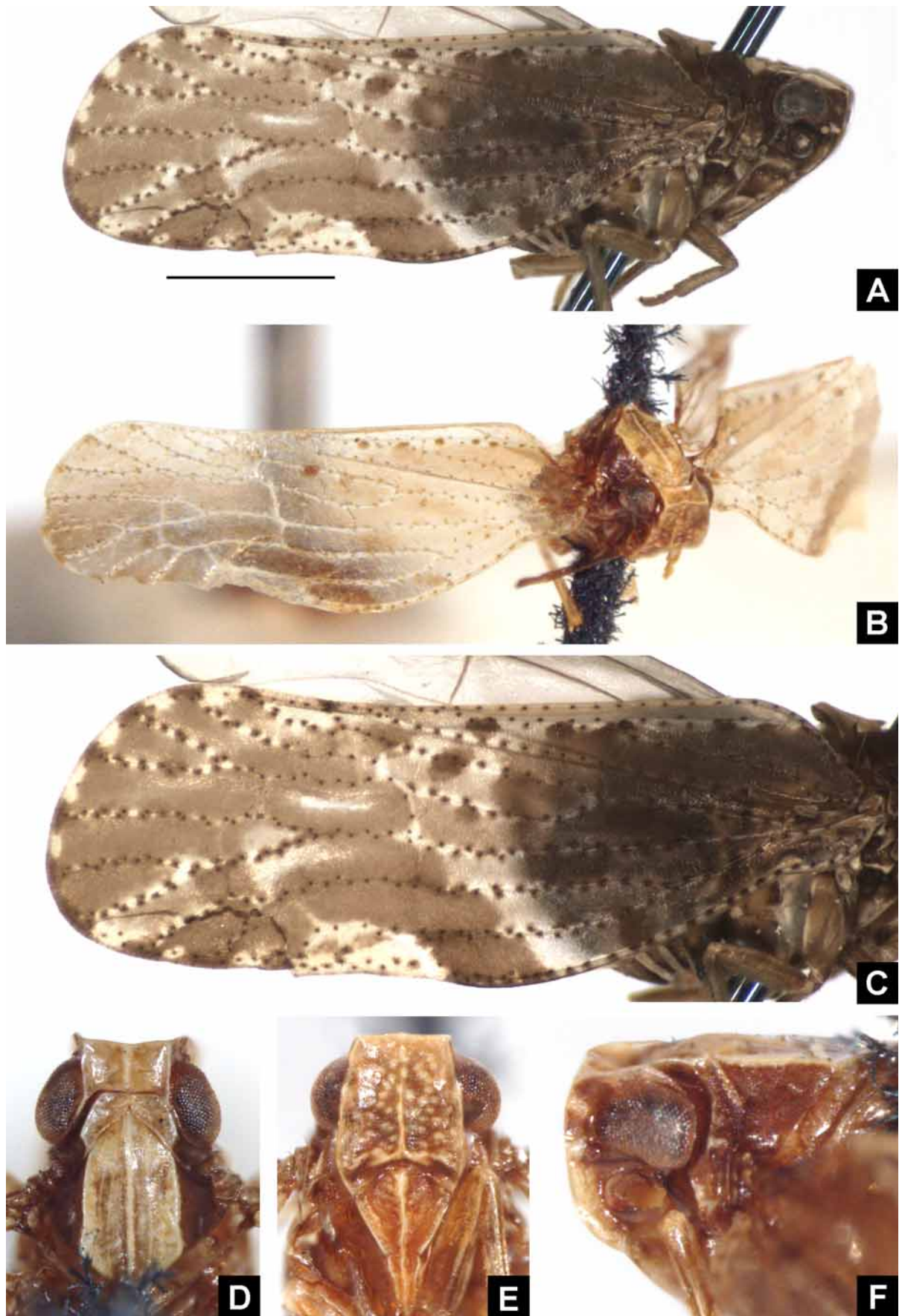


FIGURE 6. *Kirbyana australis*: A, B habitus lateral (B holotype); C forewing; D dorsum (holotype); E face (holotype); F head lateral (holotype). Scalebar 1 mm applies to figure A.

Head: Vertex 1.7–1.8 times wider than long; with anterior margin angulately emarginate; median carina covering entire length of vertex; lateral carinae slightly elevated. Frons 0.9–1.0 times as long as wide; frons invisible in dorsal view; maximum width of frons less than 2x apical width; median carina incomplete, covering more than 3/4 of length of frons; lateral carinae slightly elevated. Frontoclypeal suture distinctly semicircular, bent upwards, median part not reaching lower margin of antennal scape. Lateral carinae of anteclypeus well developed. Rostrum distinctly surpassing hind coxae.

Thorax: Forewing 3.0 times longer than wide; with MP joining CuA directly without crossvein MP-CuA; with 19–27 tubercles on costa; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell or Sc+R+M fused, forming very short common stem; Sc+R forking distinctly basad of fork CuA1+CuA2; position of crossvein R-M at same level as fork MA-MP; RP apically bifid; MA apically trifid; apical cells 10.

Male genitalia: Anal tube (Figs 16B, C), triangular in dorsal view; with very large apical lobes in lateral view (Fig. 16C). Genital styles (Figs 16D, E) with inner side of basal arm bearing small tooth (Fig. 16D). Ventromedian process circular (Fig. 16D). Aedeagus (damaged) as in Fig. 16A. Phallosome ventrally with spine (a) inserting near apex of aedeagus (this spine appears to have been much longer, but being broken off). Flagellum with very long spine (b).

Remarks. The poor condition of the only known male specimen of *Kirbyana australis* (body parts carrying important diagnostic features such as antennae, hind tarsi, one hind wing and parts of one forewing are missing) complicates the search for a suitable genus for this taxon. Fennah (1980) provided an identification key to the genera of the ‘*Eucarpia*’ group. In order to key to *Eucarpia* the forewing of the specimen needs to have crossvein MP-CuA (=M₃₊₄-Cu_{1a}) at least as long as vein MP (=M₃₊₄) from M fork to this crossvein and about as long as crossvein R-M. However, in the type specimen of *Kirbyana australis* MP joins CuA directly without the presence of a crossvein MP-CuA. Therefore, and based on the following reason, placement of this species in *Kirbyana* seems more appropriate. *Kirbyana australis* matches important diagnostic features listed in descriptions of *Kirbyana* and Fennah’s (1980) identification key such as: head including eyes slightly narrower than pronotum; vertex in profile horizontal, in same line as thorax, meeting frons abruptly rectangularly; frons somewhat longer than broad; frons with median carina; frons with anterior margin angularly indented or transverse; frons widest below level of antennae; pronotum very narrow, scarcely half as long as vertex; mesonotum nearly twice as long as pronotum and vertex together; forewing with apical margin slightly convex; hindwing with simple R; absence of lateral spines on hind tibia. In his key to the genera of the Cixiidae of Australasia (adapted from Muir) Fennah (1980) uses the character state “Vertex distinctly angulately emarginate at apex” to discriminate *Kirbyana* from other related genera. *Kirbyana australis* shows this angulate emargination, though not as pronounced as e.g. in Distant’s (1906) illustration of *Kirbyana pagana* (Melichar). Tsaur & Hsu’s (2003) description of the genus lists, “vertex transverse or incised in middle”. In the type specimen of *Kirbyana australis* a parallel-sided, pale yellow stripe runs throughout the vertex, pronotum and mesonotum. Outside this stripe (delimited by the lateral carinae of the mesonotum) the pro- and mesonotum is coloured brown. This distinct colour pattern has been recorded from at least four of the six species currently placed in *Kirbyana*. *Kirbyana australis*, however, does not display the percurrent dark brown stripes along the outer surface of the hind tibiae as observed in some species of *Kirbyana*, such as *K. javana* Muir, *K. lini* Tsaur & Hsu, *K. pagana* and *K. pratti* Muir. Fennah (1980) and Tsaur & Hsu (2003) list the character state frons usually speckled with small pale spots. This feature is present in *K. australis*. The most striking feature, however, is the similarity in the venation of the forewing between *K. australis* and some other *Kirbyana* species. Fennah (1980) and Tsaur & Hsu (2003) use the length of the crossvein MP-CuA (=M₃₊₄-Cu_{1a}) in relation to the length of other crossveins as a character to differentiate between certain genera of the ‘*Eucarpia*’ group. On the forewings of the male type specimen of *K. australis*, MP joins CuA directly without the presence of a crossvein MP-CuA. This situation is also represented in Distant’s (1906; 1916) drawings of *K. pagana* and *K. deusta*. In Tsaur & Hsu’s (2003) illustration of *K. pagana*, a very short crossvein MP-CuA is present. This situation of an extremely short or missing crossvein MP-CuA may be a unique feature of *Kirbyana* within the ‘*Eucarpia*’ group.

Genus *Neocarpia* Tsaur & Hsu, 2003

Neocarpia Tsaur & Hsu, 2003: 440.

Type species: *Neocarpia maai* Tsaur & Hsu, 2003: 440, by original designation.

Morphology. Head: Head including eyes slightly narrower than pronotum. Vertex widening towards basal emargination; lateral carinae strongly elevated; subapical carina absent. Frons lacking median ocellus; median carina present. Rostrum distinctly surpassing hind coxae.

Thorax: Pronotum short, intermediate carinae curved following posterior margins of eyes. Forewings steeply tectiform; widening towards apex; apical margin rounded; Sc+R fused, forming common stem Sc+R, M emerging separately from basal cell; Sc+R forking slightly basad or at same level as fork CuA1+CuA2; crossvein MP-CuA about as long as or longer than vein MP from M fork to this veinlet; position of crossvein R-M distad of fork MA-MP; position of crossvein MP-CuA at same level as crossvein R-M; apical cells 10.

Male genitalia: Genital styles as in Figs 17D, E, with inner side of basal arm bearing a small tooth.

Female genitalia: Ovipositor elongate, orthopteroid, slightly curved upwards, reaching or slightly surpassing anal style; 8th sternite medially very long, slightly bent dorsad, posterior margin u-shaped; anal segment square (as long as wide) or rectangular (slightly longer than wide) in dorsal view; anal style as long as wide or slightly longer than wide; 9th tergite without wax plates.

Remarks. *Neocarpia* has only been represented by one species from Taiwan, *N. maai*. This species and the Australian species described below share many characters, i.e. venation of the forewing, shape of genital spines and arrangement of spines on the phallosome (except that *N. rhizophorae* has one fewer spine than *N. maai*). Nevertheless, the two species differ in the chaetotaxy of the 2nd hind tarsomere. Tsaur & Hsu (2003) observed eight apical teeth in *N. maai* whereas *N. rhizophorae* bears only six to seven apical teeth. Tsaur & Hsu (2003) list the character state “transverse veinlet M_{3+4} -Cu_{1a} much longer than M_{3+4} from M fork to this veinlet” in the description of *Neocarpia*. The holotype of *N. rhizophorae* shows a situation where on one forewing the transverse veinlet M_{3+4} -Cu_{1a} (= crossvein MP-CuA) is about as long as M_{3+4} (= MP) from M fork to this veinlet, however on the other forewing the transverse veinlet M_{3+4} -Cu_{1a} is distinctly longer than M_{3+4} from M fork to this veinlet. In the female paratypes of *N. rhizophorae* both of those veinlets are about the same length.

Neocarpia rhizophorae Löcker, sp. nov.

(Figs 7, 17)

Types. *Holotype* ♂, AUSTRALIA, Qld: 25 km NW Townsville, Saunders Beach, 19°09.5'S, 146°36.0'E, collected in mangrove forest on *Rhizophora stylosa*, RS9511.P030, 25.iv.1995 (D.W. Burrows) (ASCU ASCTHE003483). *Paratypes*, NT: 1 ♀, E. Alligator Riv., Kakadu, 19.vi.1982, [KTG; Q4; K2247] (W. Houston) (QDPI). Qld: 2 ♀, Eurimbula, Mangroves, 28.iii.1975 (D.K. McAlpine) (AMS). WA: 1 ♀, Prince Regent River Reserve, 15°37'S, 125°18'E, ex mangrove swamp, 30.viii.1974 (W.J. Bailey, K.T. Richards) (ASCU).

Etymology. This species has been collected on the mangrove, *Rhizophora stylosa* Griffith (Rhizophoraceae).

Colour. Head mid brown with numerous pale dots, carinae pale except for concolorous median carina on postclypeus. Pro- and mesonotum light to mid brown with pale carinae; mesonotum with pale dots on disc between lateral carinae. Forewings hyaline transparent, often with scattered brown marks and brown areas, veins light brown, crossveins mid brown, tubercles mid brown, pterostigma light brown. Abdomen light to mid brown, legs light brown.

Morphology. Body length: ♂ 5.2 mm; ♀ 5.8–6.7 mm.

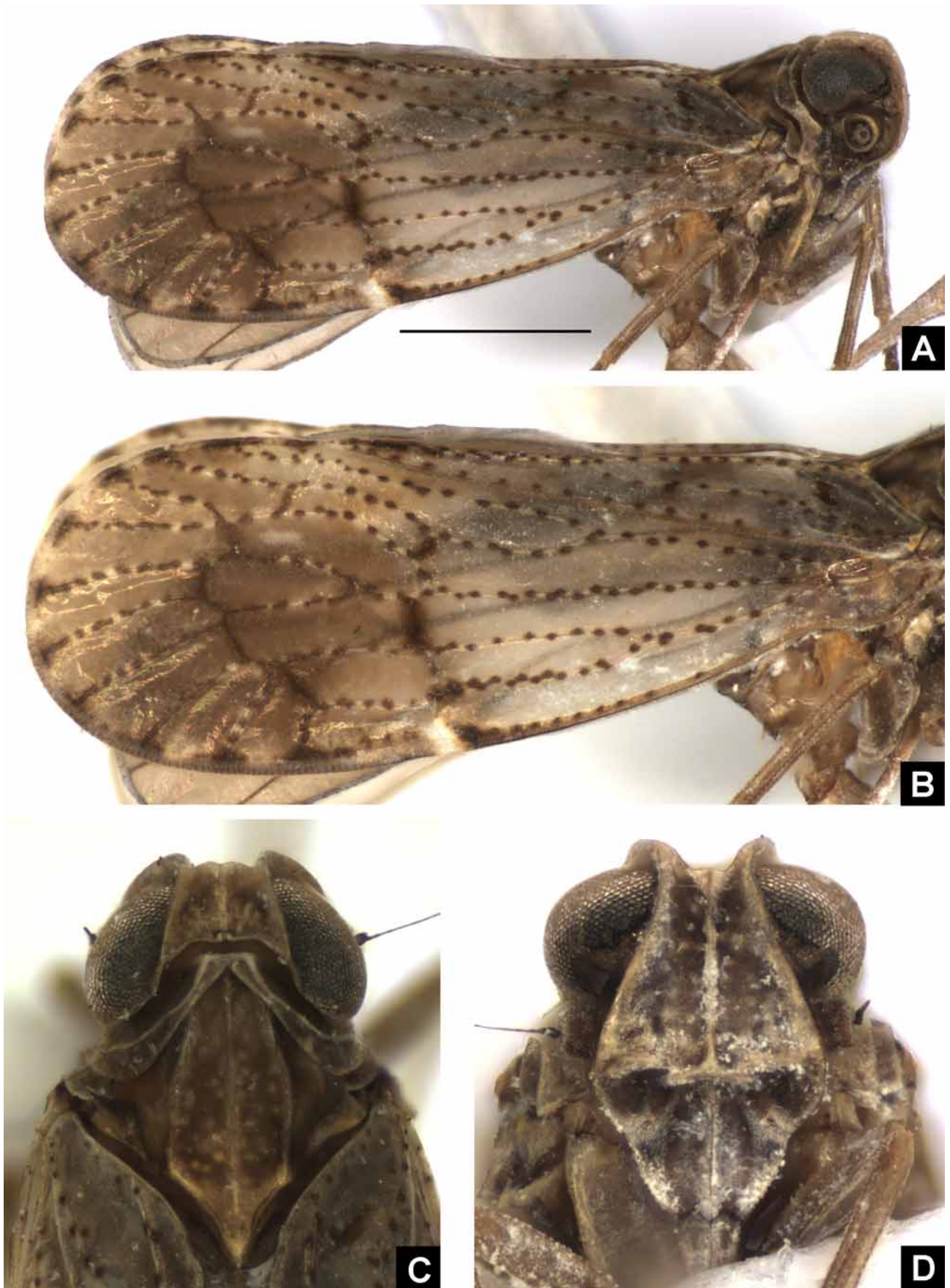


FIGURE 7. *Neocarpia rhizophorae*: A habitus lateral (holotype); B forewing (holotype); C dorsum (holotype); D face (holotype). Scalebar 1 mm applies to figure A.

Head: Vertex 1.4–1.7 times wider than long; with or without median carina (if present, not elevated but differently coloured than remainder of vertex). Frons 0.8–0.9 times as long as wide; frons invisible in dorsal view; maximum width more than twice apical width, broadening over a very short distance, therefore lateral carinae distinctly concave; position of maximum width of frons more or less around centre of frontoclypeal suture; median carina complete; lateral carinae strongly elevated. Frontoclypeal suture distinctly semicircular, bent upwards, median part just reaching lower margin of antennal scape. Lateral carinae of anteclypeus well developed. Subapical segment of rostrum 1.6–1.9 times longer than apical segment.

Thorax: Forewing 2.9–3.0 times longer than wide; with about 9–16 tubercles on Costa; RP apically bifid; MA apically trifid. Hind leg: tibia without lateral spines, with 6 apical teeth (innermost tooth larger and more sclerotised than adjacent tooth); 1st tarsomere with 6–7 apical teeth; 2nd tarsomere with 7 (rarely 6) apical teeth and 0–3 very fine setae underneath row of apical teeth (no platellae).

Male genitalia: Anal tube as in Figs 17B, C. Genital styles as in Figs 17D, E, with inner side of basal arm bearing small tooth. Ventromedian process triangular (Fig. 17D). Aedeagus as in Fig. 17A. Phallosome right laterally with strong, sclerotised spine (a) and dorsally with hook-shaped flattened ridge. Flagellum ventrally with very large spine (b).

Remarks. This species can easily be distinguished from the Taiwanese type species *N. maai* by the presence of a very long spine on the flagellum, which protrudes beyond the apex of the flagellum and by the chaetotaxy of the 2nd hind tarsomere.

Genus *Nesochlamys* Kirkaldy, 1907

Nesocharis Kirkaldy, 1907: 110 preoccupied by *Nesocharis* Alexander, 1903 (Aves).

Type species: *Nesocharis kalypso* Kirkaldy, 1907, by monotypy.

Nesochlamys Kirkaldy, 1907: 115

Type species: *Nesochlamys vitiensis* Kirkaldy, 1907.

Notes: Since the name *Nesocharis* was preoccupied by the bird genus *Nesocharis* Alexander, Fennah (1950) used *Nesochlamys* as the first available name for the genus without comment. Unfortunately, he still used *Nesocharis* in his key to genera (Fennah 1950).

Morphology. Body length: ♂ 3.1–3.9 mm.

Head: Head including eyes much narrower than pronotum. Vertex with strongly angulated anterior margin; median carina distinct, covering 1/2–3/4 of length of vertex; lateral carinae strongly elevated; subapical carina absent or present. Frons invisible in dorsal view; maximum width of frons more than twice apical width, steadily widening; position of maximum width of frons slightly dorsad of centre of frontoclypeal suture; median carina complete; lateral carinae slightly elevated. Frontoclypeal suture slightly semicircular, bent upwards, median part not reaching lower margin of antennal scape. Lateral carinae of anteclypeus weakly developed or absent. Rostrum not or just reaching hind coxae; subapical segment of rostrum 1.1–1.3 times longer than apical segment.

Thorax: Forewing with Sc+R+M fused, forming common stem; MA apically bifid. Hind tibia with 5 apical teeth.

Female genitalia: Ovipositor elongate, orthopteroid, slightly curved upwards, reaching or surpassing anal style; 8th sternite medially very short, not bent dorsad (in same plane as 7th sternite), posterior margin u-shaped; anal segment square (as long as wide) or rectangular (slightly longer than wide) in dorsal view, sometimes apex wider than base; anal style longer than wide; 9th tergite without wax plates.

Remarks. Two species were previously recognised in *Nesochlamys*, *N. vnigra* (Muir, 1931) from Vanuatu and *N. kalypso* from Fiji (= *N. vitiensis*). *Nesochlamys* has not previously been recorded from Australia. In the course of this project five species of *Nesochlamys* were found in the Australian material. None of the species displays the distinct colour pattern (black, v-shaped mark on the forewings) of *N. vnigra*. *Nesochlamys kalypso* can be distinguished from the Australian species by the presence of a pointed tip on the apical lobes of the anal tube (rounded tips in Australian species). The Australian material of *Nesochlamys* contains 40

females collected in North Queensland and, due to similarity in external features, these could only be identified to genus level.

Key to Australian species of *Nesochlamys* Kirkaldy

- 1 Aedeagus with a long, flattened spine-like structure directed caudad on the lateral side of the aedeagus (Fig. 20A). .
.....*N. jubatus* Löcker, **sp. nov.**
- Aedeagus without such a caudally directed, flattened spine. 2
- 2(1) Aedeagus with two bifurcated spines (Fig. 21A).*N. pandikros* Löcker, **sp. nov.**
- Aedeagus with fewer than two bifurcated spines. 3
- 3(2) Aedeagus left laterally with two, long, intertwined spines (a, b) and ventrally with a long spine (c), bearing two short spines (d, e) pointing in opposite directions (Figs 22A, B)*N. yiralli* Löcker, **sp. nov.**
- Aedeagus not as above; with one bifurcated and two single spines. 4
- 4(3) Aedeagus with branches of bifurcated spine (b) equal in length and curving in opposite directions (Fig. 19A, B).....
.....*N. contrarius* Löcker, **sp. nov.**
- Aedeagus with branches of bifurcated spine (b) unequal in length and pointing in different (but not opposite) directions (Fig. 18A).*N. capensis* Löcker, **sp. nov.**

Nesochlamys capensis Löcker, **sp. nov.**

(Figs 8A–C, 18)

Types. *Holotype* ♂, **AUSTRALIA, Qld:** 3 km W of Cape Tribulation, 500 m, 20.ix.–7.x.1982 (Monteith, Yeates & Thompson) (QM T.156365). *Paratype, Qld:* 1 ♂, 4 km W of Cape Tribulation, 720 m, baited flight trap, rainforest, 23.ix.–7.x.1982 (Monteith, Yeates & Thompson) (QM).

Etymology. Named after the type locality, Cape Tribulation.

Colour. Vertex light brown near basal emargination, mid brown apically. Face mid brown, carinae concolorous, except for pale lateral carinae of frons. Pronotum light brown, mesonotum dark brown. Forewings hyaline colourless with some light to mid brown patches; veins and tubercles concolorous with cells; apical parts of veins near pterostigma darkened; pterostigma light brown. Abdomen light to mid brown. Legs light brown, femora slightly darker.

Morphology. Body length: ♂ 3.6–3.9 mm.

Head: Vertex 0.7 times as wide as long; with median carina covering 1/2–3/4 of length of vertex. Frons 1.3–1.4 times longer than wide. Rostrum not reaching hind coxae.

Thorax: Forewing with about 15 tubercles on costa; Sc+R forking basad of fork CuA1+CuA2; position of crossvein R-M distad or at same level as fork MA-MP; RP apically trifid; apical cells 10. Hind leg: 1st tarsomere with 6 apical teeth; 2nd tarsomere with 6 (rarely 7) apical teeth and three very fine setae.

Male genitalia: Anal tube as in Figs 18B, 18C. Genital styles (Figs 18D, E) apically with numerous fine setae. Ventromedian process of pygofer trapezoid (Fig. 18D). Aedeagus (Fig. 18A): phallosome left laterally with long spine (a), inserted near apex and bifurcated spine (b) with branches of unequal length; ventrally with long, flattened spine (c) directed cephalad. Flagellum without spines.

Remarks. This species can be distinguished from the other Australian species of *Nesochlamys* by the arrangement of spines on the aedeagus (two single spines and one bifurcated spine with branches of unequal length as in Fig. 18A).

Nesochlamys contrarius Löcker, **sp. nov.**

(Figs 8D–G, 19)

Types. *Holotype* ♂, **AUSTRALIA, Qld:** 26 km up Tinaroo Ck Rd via Mareeba, 29.ix.–11.xi.1983 (Storey & Brown) (QM T.156366, originally from QDPI). *Paratypes, Qld:* 9 ♂, same data as holotype (7 in QDPI, 2 in

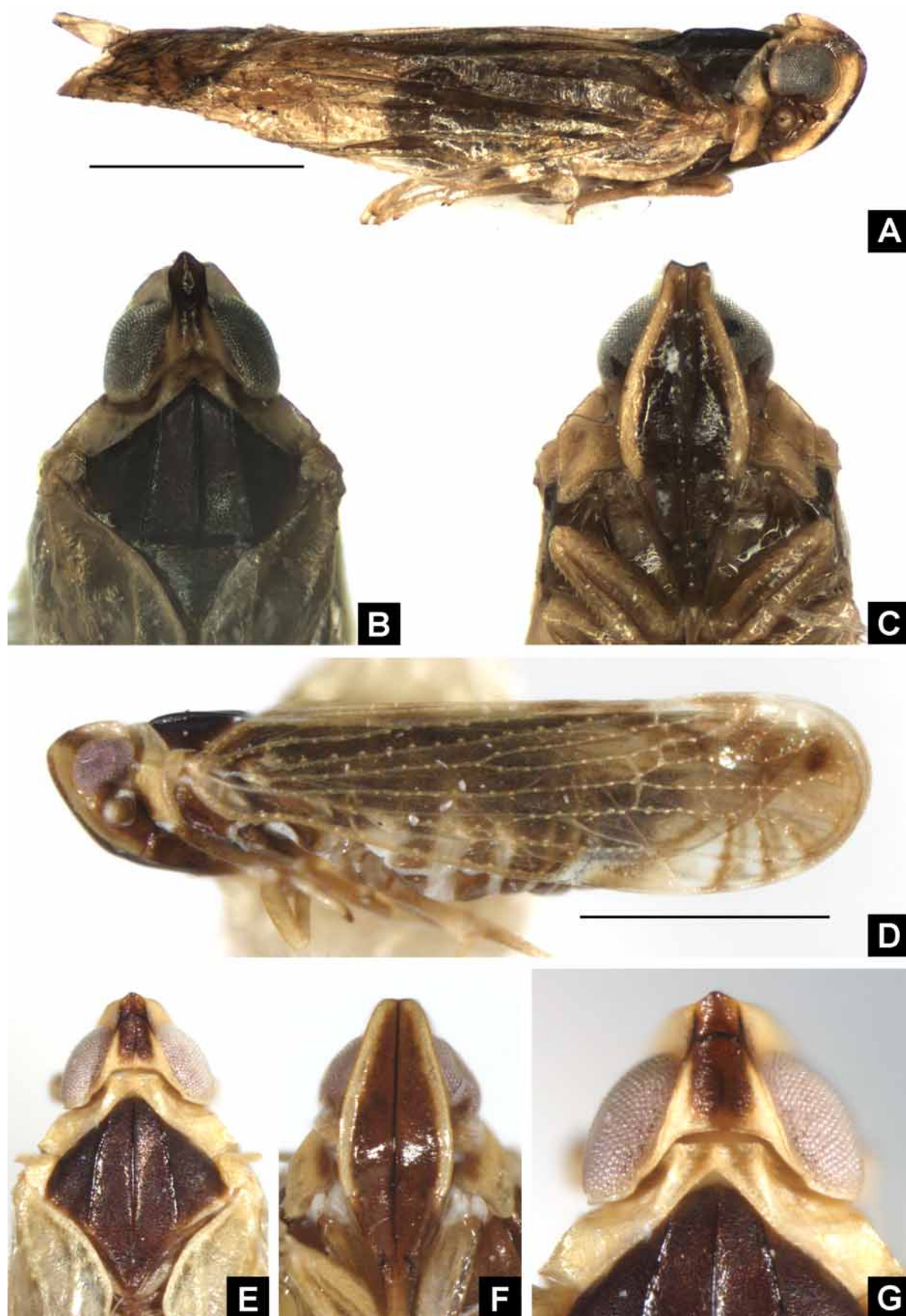


FIGURE 8. *Nesochlamys capensis*: A habitus lateral (holotype); B dorsum (holotype); C face (holotype). Scalebar 1 mm applies to figure A. *Nesochlamys contrarius*: D habitus lateral (holotype); E dorsum (paratype); F face (holotype); G vertex dorsal (paratype). Scalebar 1 mm applies to figure D.

ASCU); 1 ♂, same data, 24.viii.–29.ix.1983 (QDPI); 1 ♂, GS1 Mt Haig, 17.06S, 145.36E, 1150 m, malaise trap, 29.ix.–31.x.1995 (L. Umbach) (ANIC).

Etymology. The Latin term ‘*contrarius*’ means ‘opposite’ and refers to a spine on the aedeagus which is bifurcated with its two branches curving in opposite directions.

Colour. Vertex light brown near basal emargination, mid to dark brown apically. Face mid (rarely dark) brown, carinae concolorous, except for pale lateral carinae of frons. Pronotum light brown, mesonotum dark brown. Forewings hyaline colourless with some light to mid brown patches; veins and tubercles concolorous with cells; apical parts of veins near pterostigma darkened; pterostigma light brown. Abdomen light to mid brown. Legs light brown, femora slightly darker.

Morphology. Body length: ♂ 3.2–3.6 mm.

Head: Vertex 0.7–1.0 times as wide as long; with median carina covering 3/4 of length of vertex. Frons 1.4–1.7 times longer than wide. Rostrum just reaching hind coxae.

Thorax: Forewing 3.5–3.9 times longer than wide; with about 8–15 tubercles on costa; Sc+R forking basad or distad of fork CuA1+CuA2; position of crossvein R-M basad or slightly distad of fork MA-MP; RP apically trifid; apical cells 10. Hind leg: 1st tarsomere with 5–6 apical teeth; 2nd tarsomere with 6 (rarely 5) apical teeth and three very fine setae.

Male genitalia: Anal tube as in Figs 19C, 19D. Genital styles (Figs 19E, F) apically with numerous fine setae. Ventromedian process of pygofer trapezoid with a shallow incision at the top (Fig. 19E). Aedeagus (Figs 19A, B): phallosome left laterally with long spine (a) and large, bifurcated spine (b) with two branches curving in opposite directions; ventrally with long spine (c). Flagellum without spines.

Remarks. This species can be distinguished from the other Australian species by the presence of a large, bifurcated spine (b) with its two branches of equal length and curving in opposite directions (Figs 19A, B).

Nesochlamys jubatus Löcker, sp. nov.

(Figs 9A–C, 20)

Types. *Holotype* ♂, AUSTRALIA, Qld: Bellenden Ker Range, summit TV station, 1560m, 1.–7.xi.1981 (Earthwatch, QM T.1563673).

Etymology. The Latin term ‘*jubatus*’ means ‘maned, crested’ and refers to the dense bunch of setae on the apex of the genital styles.

Colour. Vertex light brown near basal emargination, dark brown apically. Face mid brown, carinae concolorous, except for pale lateral carinae of frons. Pronotum light brown, mesonotum dark brown. Forewings hyaline, colourless with some light to mid brown patches; veins and tubercles concolorous with cells; apical parts of veins near pterostigma darkened; pterostigma light brown. Legs light brown, femora slightly darker.

Morphology. Body length: ♂ 3.7 mm.

Head: Vertex 0.7 times as wide as long; with median carina covering about 1/2 of length of vertex. Frons 1.4 times longer than wide.

Thorax: Forewing 3.3 times longer than wide; with 19 tubercles on costa; Sc+R forking basad of fork CuA1+CuA2; RP apically trifid; apical cells 10. Hind leg: 1st and 2nd tarsomere with 6 apical teeth.

Male genitalia: Anal tube (Figs 20B, C) in dorsal view very wide apically, tapering towards base (Fig. 20B). Genital styles (Figs 20D, E) apically with numerous fine setae, some grouped together to form dense bunch of setae pointing dorsocephalad. Ventromedian process of pygofer trapezoid (Fig. 20D). Aedeagus (Fig. 20A): phallosome left laterally with rounded, bifurcated spine (a), inserted near apex of aedeagus and flattened, caudally directed, spine-like structure, inserted near base of aedeagus. Flagellum without spines.

Remarks. This species differs from the other Australian species of *Nesochlamys* by the presence of a flattened, caudally directed, spine-like structure, inserted near the base of the aedeagus (Fig. 20A).

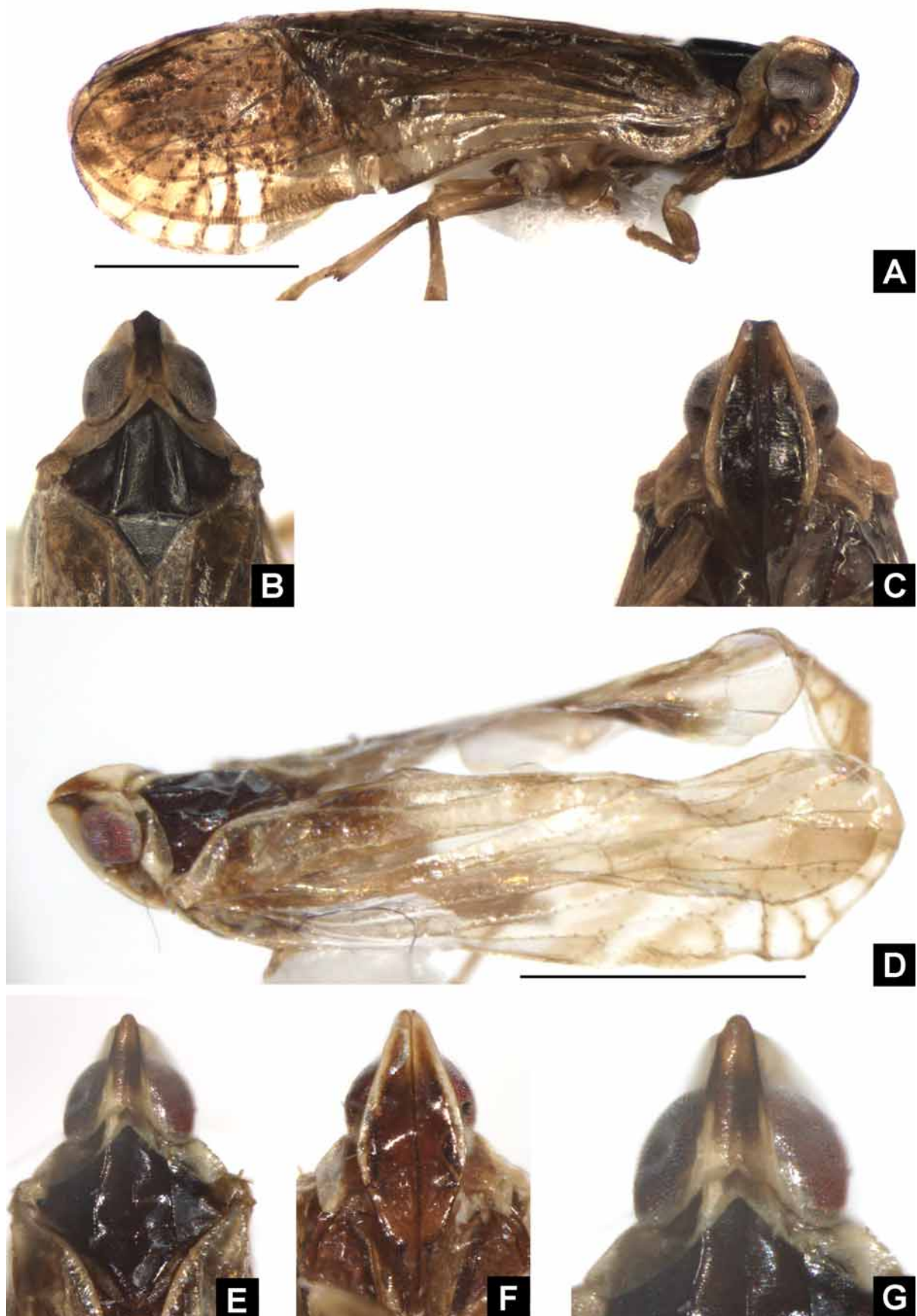


FIGURE 9. *Nesochlamys jubatus*: A habitus lateral (holotype); B dorsum (holotype); C face (holotype). Scalebar 1 mm applies to figure A. *Nesochlamys pandikros*: D habitus lateral (paratype); E dorsum (paratype); F face (paratype); G vertex dorsal (paratype). Scalebar 1 mm applies to figure D.

***Nesochlamys pandikros* Löcker, sp. nov.**

(Figs 9D–G, 21)

Types. *Holotype* ♂, AUSTRALIA, Qld: Bellenden Ker Range, Cable Tower 5, 500 m, malaise trap, ix.–x.1982 (S. Montague) (QM T.156368). *Paratype*, Qld: 1 ♂, same data, x.–xii.1982 (QM).

Etymology. The Greek term ‘*pan-*’ means ‘all, every’ and ‘*dikros*’ means ‘forked’ and refers to the spines on the aedeagus, which are all bifurcated.

Colour. Vertex light brown near basal emargination, mid brown apically. Face mid brown, carinae concolorous, except for pale lateral carinae of frons. Pronotum light brown, mesonotum mid to dark brown. Forewings hyaline colourless with numerous light brown patches; veins and tubercles concolorous with cells; apical parts of veins near pterostigma darkened; pterostigma light brown. Legs light brown, femora slightly darker.

Morphology. Body length: ♂ 3.3 mm.

Head: Vertex 0.5 times as wide as long; with median carina covering 1/2–3/4 of length of vertex. Frons 1.5–1.6 times longer than wide. Rostrum just reaching hind coxae.

Thorax: Forewing 3.7 times longer than wide; with 13 tubercles on costa; Sc+R forking basad of fork CuA1+CuA2; position of crossvein R-M basad of fork MA-MP; RP apically bifid; 8–9 apical cells. Hind leg: 1st and 2nd tarsomere with 6 apical teeth.

Male genitalia: Anal tube as in Figs 21B, 21C. Genital styles (Figs 21D, E), apically with numerous fine setae. Ventromedian process of pygofer trapezoid (Fig. 21D). Aedeagus (Fig. 21A): phallosome left laterally with broad, well sclerotised, bifurcated spine (a); ventrally with less sclerotised, bifurcated spine (b) with one short and one very long, slender branch. Flagellum without spines.

Remarks. This species differs from all other Australian species of *Nesochlamys* by the presence of two bifurcated spines on the aedeagus (Fig. 21A).

***Nesochlamys yiralli* Löcker, sp. nov.**

(Figs 10A–C, 22)

Types. *Holotype* ♂, AUSTRALIA, Qld: Mt Lewis, 14.–25.xi.1980 (R.I. Storey) (QM T.156369, originally from QDPI). *Paratypes*, Qld: 3 ♂, same data as holotype (1 in QDPI, 2 in ASCU).

Etymology. The term ‘*yiralli*’ means ‘root’ in Gooniyandi, an aboriginal language spoken in Western Australia (Thieberger & McGregor, 1994) and refers to the shape of a spine on the aedeagus which resembles a root with tiny side-roots.

Colour. Vertex light brown near basal emargination, mid to dark brown apically. Face mid brown, carinae concolorous, except for pale lateral carinae of frons. Pronotum light brown, mesonotum dark brown. Forewings hyaline with some light to mid brown patches; veins and tubercles concolorous with cells; apical parts of veins near pterostigma darkened; pterostigma light brown. Abdomen mid brown. Legs light brown.

Morphology. Body length: ♂ 3.1–3.4 mm.

Head: Vertex 0.8–1.0 times as wide as long; with median carina covering 1/2–3/4 of length of vertex. Frons 1.4–1.5 times longer than wide. Rostrum not reaching hind coxae.

Thorax: Forewing 3.5–4.0 times longer than wide; with about 16–18 tubercles on costa; Sc+R forking slightly basad or at same level as fork CuA1+CuA2; position of crossvein R-M basad or at same level as fork MA-MP; RP apically bifid; apical cells 9–10. Hind leg: 1st tarsomere with 6 apical teeth; 2nd tarsomere with 6 apical teeth and three very fine setae.

Male genitalia: Anal tube as in Figs 22C, 22D. Genital styles (Figs 22E, F) apically with numerous fine setae. Ventromedian process of pygofer trapezoid with a shallow incision at the top (Fig. 22E). Aedeagus (Figs 22A): phallosome left laterally with two, long, intertwined spines (a, b) and ventrally with long spine (c), bearing two short spines (d, e) pointing in opposite directions. Flagellum without spines.

Remarks. This species can easily be distinguished from all other Australian species of *Nesochlamys* by

the presence of the long spine (c), bearing two short spines (d, e) pointing in opposite directions on the ventral side of aedeagus (Figs 22A, B).



FIGURE 10. *Nesochlamys yiralli*: A habitus lateral (holotype); B dorsum (holotype); C face (holotype). Scalebar 1 mm applies to figure A.

Genus *Eucarpia* Walker, 1857

Eucarpia Walker, 1857: 159.

Type species: *Eucarpia univitta* Walker, 1857, by monotypy.

Notes: Our study has shown that *Eucarpia*, as defined by Fennah (1980), is absent from Australia. See further comments above under *Kirbyana australis*.

Discussion

Eucarpiini was created by Emeljanov (2002) to accommodate ten genera from the Palearctic, Ethiopian, Oriental, Australian and Oceanic Regions (Holzinger *et al.* 2002). In their revision of the Cixiidae from Taiwan, Tsaor and Hsu (2003) listed *Kirbyana* Distant, 1906 and *Eucarpia* Walker, 1857 under Pintaliini

Metcalf, 1938. These two genera were previously part of the tribe Eucarpiini. Tsaur and Hsu (2003) did not indicate that these genera were originally in Eucarpiini and that they were transferring them to Pintaliini. This suggests that Tsaur and Hsu may not have been aware of Emeljanov's introduction of the tribe Eucarpiini. Emeljanov (2002) gives the following character state as a synapomorphy for Pintaliini, "Hind margin of the forewing with convexity situated between the clavus apex and icu". The Australian taxa examined in this project and the line drawings of the forewings of the Taiwanese species do not show any convexity between the apex of clavus and icu on the forewings. Therefore, these genera should not be placed in Pintaliini. The same applies to the genus *Neocarpia* which is described as new by Tsaur and Hsu (2003). However, detailed analyses of the world fauna, which are beyond the scope of this project, are needed to establish clearly defined concepts for both tribes.

The following character states were observed in all Australian Eucarpiini: median ocellus on frons missing (except for one specimen of *Dilacreon* (*Dilacreon*) *granulinervis* which possessed a very small and indistinct ocellus); lateral carinae of frons foliaceous, distinctly extending laterally, concealing base of antennae; median carina and lateral carinae of postclypeus well developed; median carina of anteclypeus well developed; forewings in resting position steeply tectiform; forewing with concavity at costal border; hind margin of forewing without convexity between clavus apex and icu; icu distad of apex of clavus; additional subapical cell between branches of R absent; MP apically bifid; CuA1 apically unforked; hind tibiae lacking lateral spines and 1st hind tarsomere without platellae or fine setae. A phylogenetic analysis of the world Cixiidae fauna is needed to determine whether these represent synapomorphies of the tribe Eucarpiini.

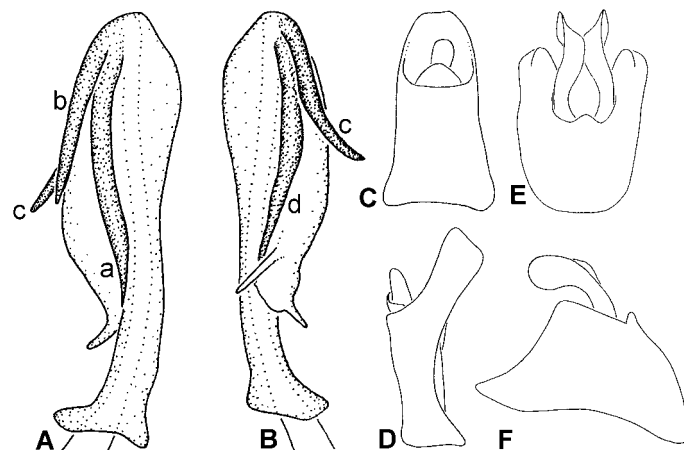


FIGURE 11. *Bajauana austrina*: A, B aedeagus (holotype), (A) left lateral (B) right lateral; C, D anal tube; E, F genital styles (holotype).

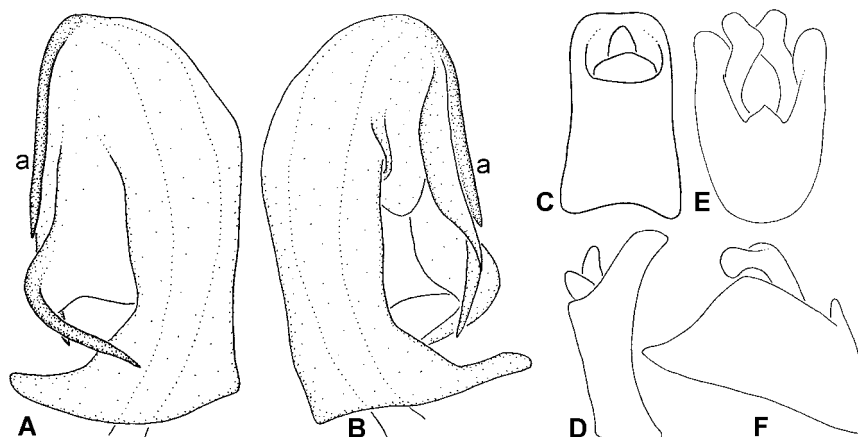


FIGURE 12. *Bajauana acuminata*: A, B aedeagus (holotype), (A) left lateral (B) right lateral; C, D anal tube (holotype); E, F genital styles (holotype).

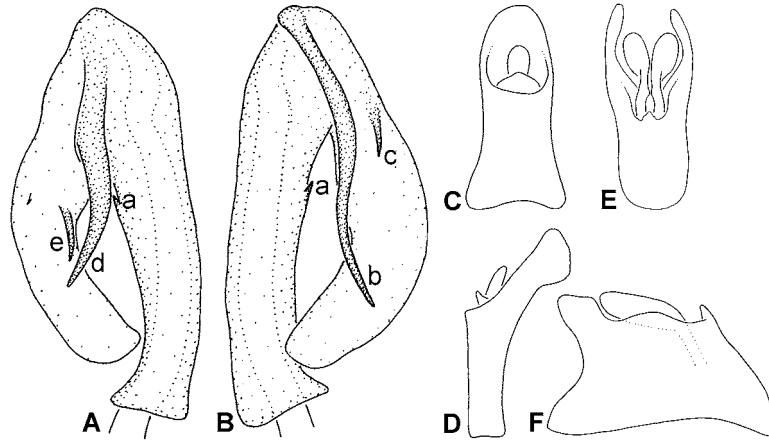


FIGURE 13. *Dilacreon (Dilacreon) akethe*: A, B aedeagus (holotype), (A) left lateral (B) right lateral; C, D anal tube (holotype); E, F genital styles (holotype).

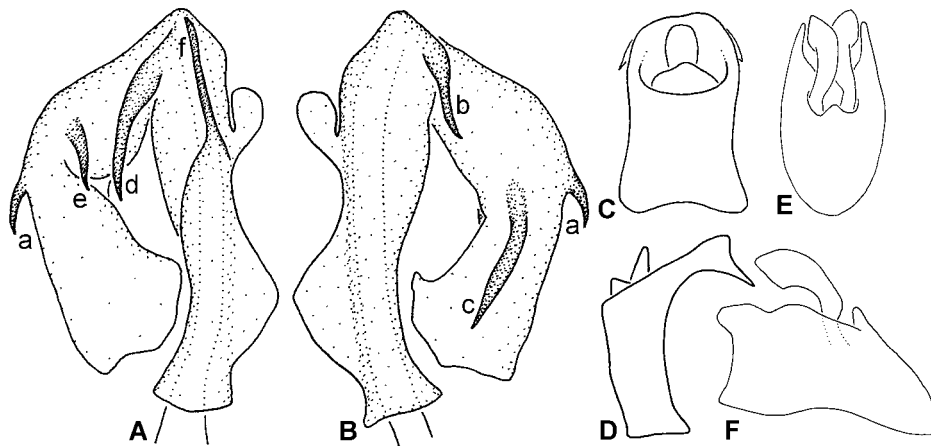


FIGURE 14. *Dilacreon (Dilacreon) granulinervis*: A, B aedeagus, (A) left lateral (B) right lateral; C, D anal tube; E, F genital styles.

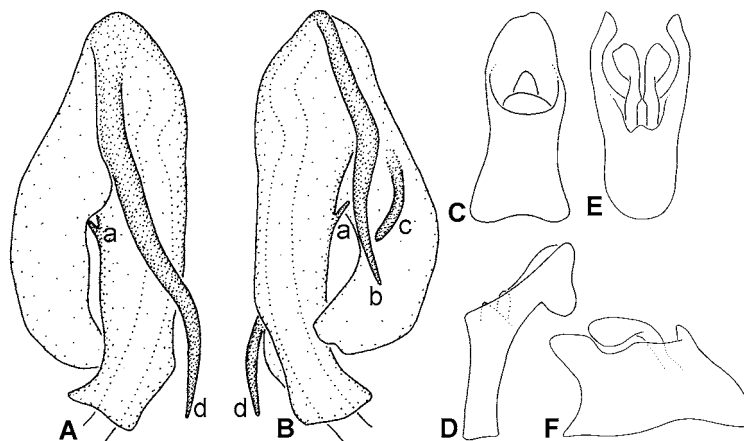


FIGURE 15. *Dilacreon (Dilacreon) ispi*: A, B aedeagus (holotype), (A) left lateral (B) right lateral; C, D anal tube (holotype); E, F genital styles (holotype).

The Australian Eucarpiini is restricted in its distribution to the northern parts of Queensland, Northern Territory and Western Australia except for *Bajauana austrina* and *Dilacreon (D.) granulinervis*, both of which are also recorded from Indonesia. However, the shape of the head and the structure of the male genitalia (i.e.

the arrangement of spines on the aedeagus) indicate that *Dilacreon* (*D.*) *akethe* and *D.* (*D.*) *ispi* are closely related to *D.* (*D.*) *semiramis* Fennah, 1980, a species from New Guinea. It is possible that a number of species in Australia will also be recorded from New Guinea as more study on the New Guinean fauna is undertaken.

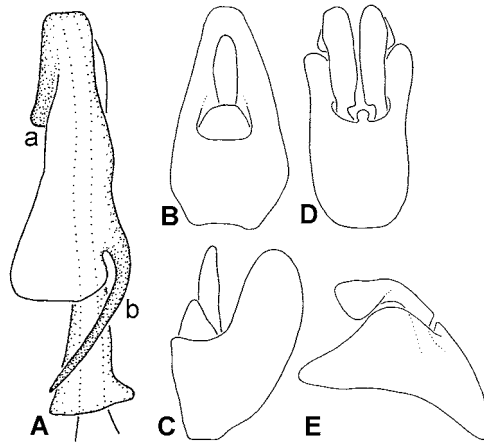


FIGURE 16. *Kirbyana australis*: A aedeagus right lateral (damaged) (holotype); B, C anal tube (holotype); D, E genital styles (holotype).

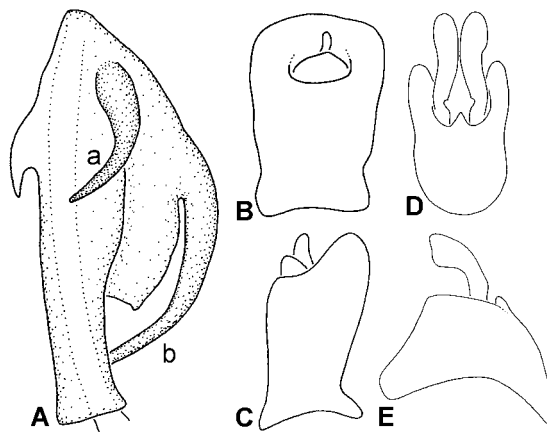


FIGURE 17. *Neocarpia rhizophorae*: A aedeagus right lateral (holotype); B, C anal tube (holotype); D, E genital styles (holotype).

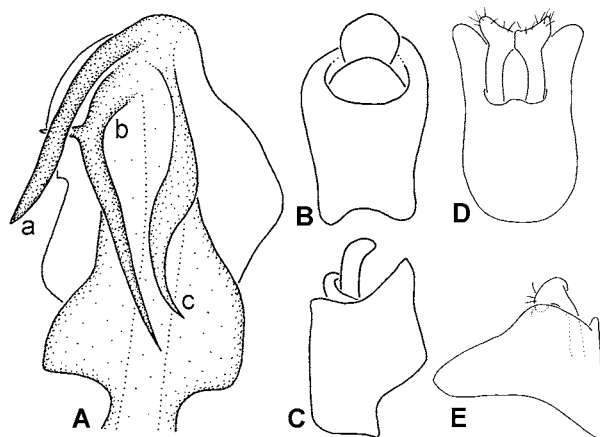


FIGURE 18. *Nesoclamys capensis*: A aedeagus ventral (paratype); B, C anal tube (paratype); D, E genital styles (paratype).

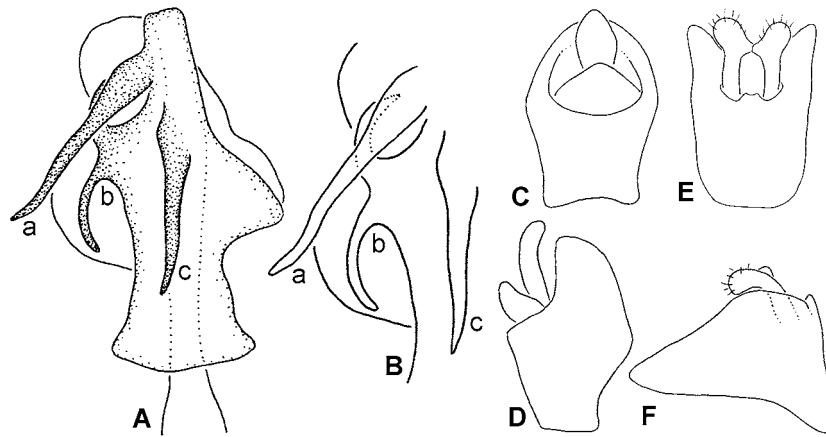


FIGURE 19. *Nesochlamys contrarius*: A, B aedeagus ventral (paratype); C, D anal tube (paratype); E, F genital styles (paratype).

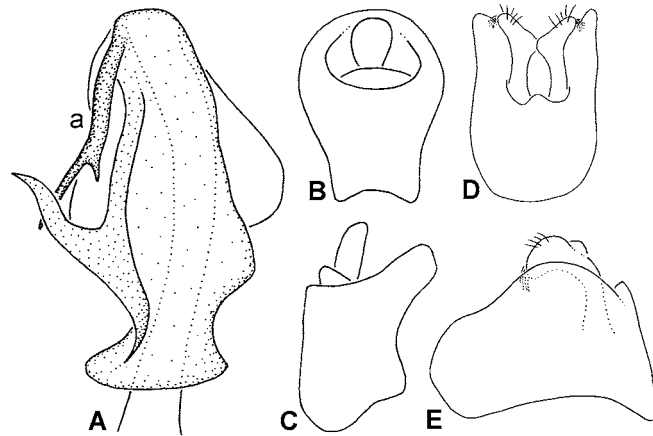


FIGURE 20. *Nesochlamys jubatus*: A aedeagus ventral (holotype); B, C anal tube (holotype); D, E genital styles (holotype).

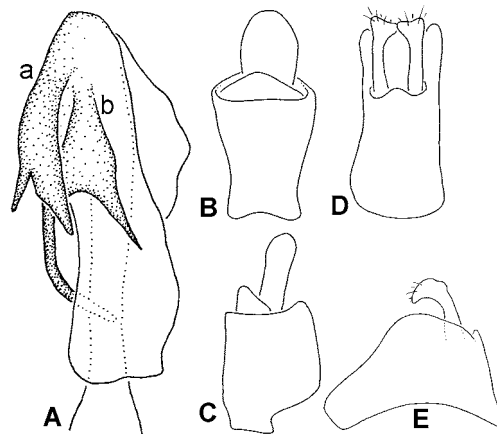


FIGURE 21. *Nesochlamys pandikros*: A aedeagus ventral (holotype); B, C anal tube (holotype); D, E genital styles (D) holotype (E) paratype.

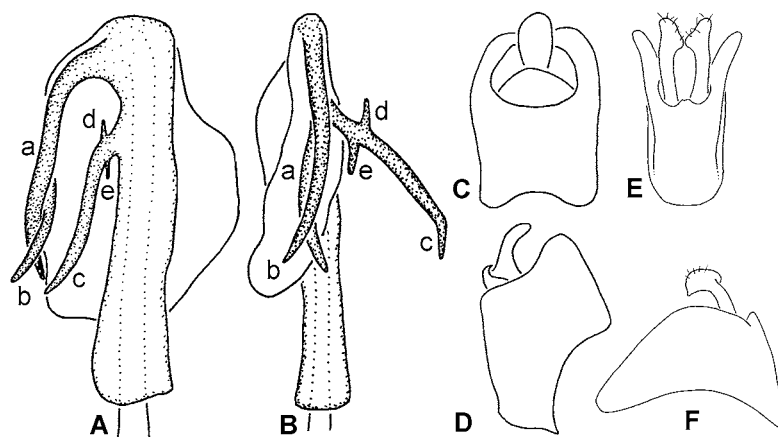


FIGURE 22. *Nesochlamys yiralli*: A, B aedeagus (paratype) (A) ventral (B) left lateral; C, D anal tube (paratype); E, F genital styles (paratype).

Acknowledgements

We are grateful to all collectors and curators of insect collections, who have enabled us to use their material for our research, in particular Keith Arakaki (BPBM), Dave Britton (AMS), Greg Daniels (UQIC), Rainer Emmrich (MTD), Geoff Monteith (QM), Desley Tree (QDPI) and Tom Weir (ANIC). This work has been undertaken by the first author as part of her PhD project. We acknowledge invaluable input in the developmental stages of this work by Marie-Claude Larivière (NZAC) without whom this project could not have been extended to include the Eucarpiini. We express our gratitude to Rainer Emmrich (MTD), Bert Gustafsson (Naturhistoriska Riksmuseet, Stockholm, Sweden), Lois O'Brien and Mick Webb (The Natural History Museum, London, United Kingdom) for their help in solving the confusion concerning Jacobi's type specimens of *Australoma praetextata* Jacobi, 1928 and *A. praetextata* var *obscura* Jacobi, 1928. Our sincere thanks go to Holger Löcker and Werner Holzinger for their generous assistance. Financial support from the Australian Biological Resources Study (ABRS), a division of the Australian Government's Department of the Environment and Heritage (DEH) and The University of Sydney and in-kind support from NSW Department of Primary Industries and Charles Sturt University are gratefully acknowledged.

References

- Distant, W.L. (1906) Rhynchota. Heteroptera-Homoptera. *The Fauna of British India, including Ceylon and Burma*, 3: 1–503.
- Distant, W.L. (1907) Rhynchotal Notes XLI. *Annals and Magazine of Natural History* (7), 19, 277–295.
- Distant, W.L. (1911) Descriptions of new genera and species of Oriental Homoptera. *Annals and Magazine of Natural History* (8), 8, 735–747.
- Distant, W.L. (1912) Descriptions of new genera and species of Oriental Homoptera. *Annals and Magazine of Natural History* (8), 9, 181–194.
- Distant, W.L. (1916) Rhynchota, Homoptera: Appendix. *Fauna of British India*, 6, 1–248.
- Emeljanov, A.F. (2002) Contribution to classification and phylogeny of the family Cixiidae (Hemiptera, Fulgoroidea). *Denisia*, 4, 103–112.
- Fennah, R.G. (1950) Fulgoroidea of Fiji. *Bulletin of the Bernice Pauahi Bishop Museum*, 202, 1–122.
- Fennah, R.G. (1956) Homoptera: Fulgoroidea. *Bernice Pauahi Museum Insects of Micronesia*, 6, 1–211.
- Fennah, R.G. (1978) Fulgoroidea (Homoptera) from Vietnam. *Annales Zoologici (Warsaw)*, 34, 207–280.
- Fennah, R.G. (1980) The genus *Bajauana* and two allied new genera in New Guinea (Fulgoroidea: Cixiidae). *Pacific Insects*, 22, 237–328.
- Fletcher, M.J. (2009 and updates) Identification keys and checklists for the leafhoppers, planthoppers and their relatives occurring in Australia and neighbouring areas (Hemiptera: Auchenorrhyncha). <http://www1.dpi.nsw.gov.au/keys/>

[leafhop/index.html](#) (accessed 12 May, 2009)

- Holzinger, W.E., Emeljanov, A.F., & Kammerlander, I. (2002) The family Cixiidae Spinola 1839 (Hemiptera: Fulgoroidea) - a Review. *Denisia*, 4, 113–138.
- Jacobi, A. (1928) Results of Dr E. Mjöberg's Swedish Scientific Expeditions to Australia 1910–1913. Rhynchota, Homoptera. 1. Fulgoridae und Cercopidae. *Arkiv for Zoologi*, 19A, 1–50.
- Kirkaldy, G.W. (1906) Bibliographical and nomenclatorial notes on the Hemiptera. No. 6. *Entomologist*, 39, 247–249.
- Kirkaldy, G.W. (1907) Leafhoppers - Supplement (Hemiptera). *Bulletin of the Hawaiian Sugar Planters' Association Division of Entomology*, 3, 1–186.
- Löcker, B., Fletcher, M.J., Larivière, M.-C., Gurr, G.M., Holzinger, W.E. & Löcker, H. (2006a) Taxonomic and phylogenetic revision of the Gelastocephalini (Hemiptera: Cixiidae). *Invertebrate Systematics*, 20, 59–160.
- Löcker, B., Fletcher, M.J., Larivière, M.-C. & Gurr, G.M. (2006b) The Australian Pentastirini (Hemiptera: Fulgoroidea: Cixiidae). *Zootaxa*, 1290, 1–138.
- Löcker, B., Fletcher, M.J. & Gurr, G.M. (2006c) First record of the planthopper tribe Mnemosynini in Australia with the description of two new species (Hemiptera: Fulgoroidea: Cixiidae). *Russian Entomological Journal*, 15(3), 287–294.
- Löcker, B., Fletcher, M.J., Holzinger, W.E. & Gurr, G.M. (2007a) Revision of the Australian Andini (Hemiptera: Fulgoroidea: Cixiidae) with a description of five new species. *Zootaxa*, 1475, 43–59.
- Löcker, B., Fletcher, M.J. & Gurr, G.M. (2007b) Revision of the genus *Innobindus* Jacobi (Hemiptera: Fulgoroidea: Cixiidae) with the description of six new species and comments on other Australian Brixini genera. *Australian Journal of Entomology*, 46, 45–55.
- Mead, F.W. & Kramer, J.P. (1982) Taxonomic study of the planthopper genus *Oliarus* in the United States (Homoptera: Fulgoroidea: Cixiidae). *Transactions of the American entomological Society*, 107, 381–569.
- Melichar, L. (1903) Homopteren-Fauna von Ceylon. 248pp.
- Metcalf, Z.P. (1936) Cixiidae. *General Catalogue of the Hemiptera, Fascicle IV Fulgoroidea*, 2, 1–269.
- Muir, F. (1913) On some new Fulgoroidea. *Proceedings of the Hawaiian Entomological Society*, 2, 237–269.
- Muir, F. (1931) Descriptions and records of Fulgoroidea from Australia and the South Pacific Islands. No 1. *Records of the Australian Museum*, 18, 63–83.
- Stål, C. (1859) Novae quaedam Fulgorinorum formae speciesque insigniores. *Berliner Entomologische Zeitschrift*, 3, 313–327.
- Thieberger, N. & McGregor, W. (1994) *Macquarie Aboriginal words*. The Macquarie Library Pty Ltd: Sydney, Australia, pp. 724.
- Tsaur, S.-C. & Hsu, T.-C. (2003) The Cixiidae of Taiwan, Part VII: Tribe Pintaliini (Hemiptera: Fulgoroidea). *Zoological Studies*, 42(3), 431–443.
- Walker, F. (1857) Catalogue of the Homopterous insects collected at Sarawak, Borneo, by Mr. A. R. Wallace, with descriptions of new species. *Journal and Proceedings of the Linnaean Society*, 1, 141–160.
- Walker, F. (1870) Catalogue of the Homopterous insects collected in the Indian Archipelago by Mr. A. R. Wallace, with descriptions of new species. *Journal of the Linnaean Society, Zoology*, 10, 82–193.